SCIENTIFIC AMERICAN

(35)

WHENCE THE INDIAN?
By Dr. Ales Hrdlicka

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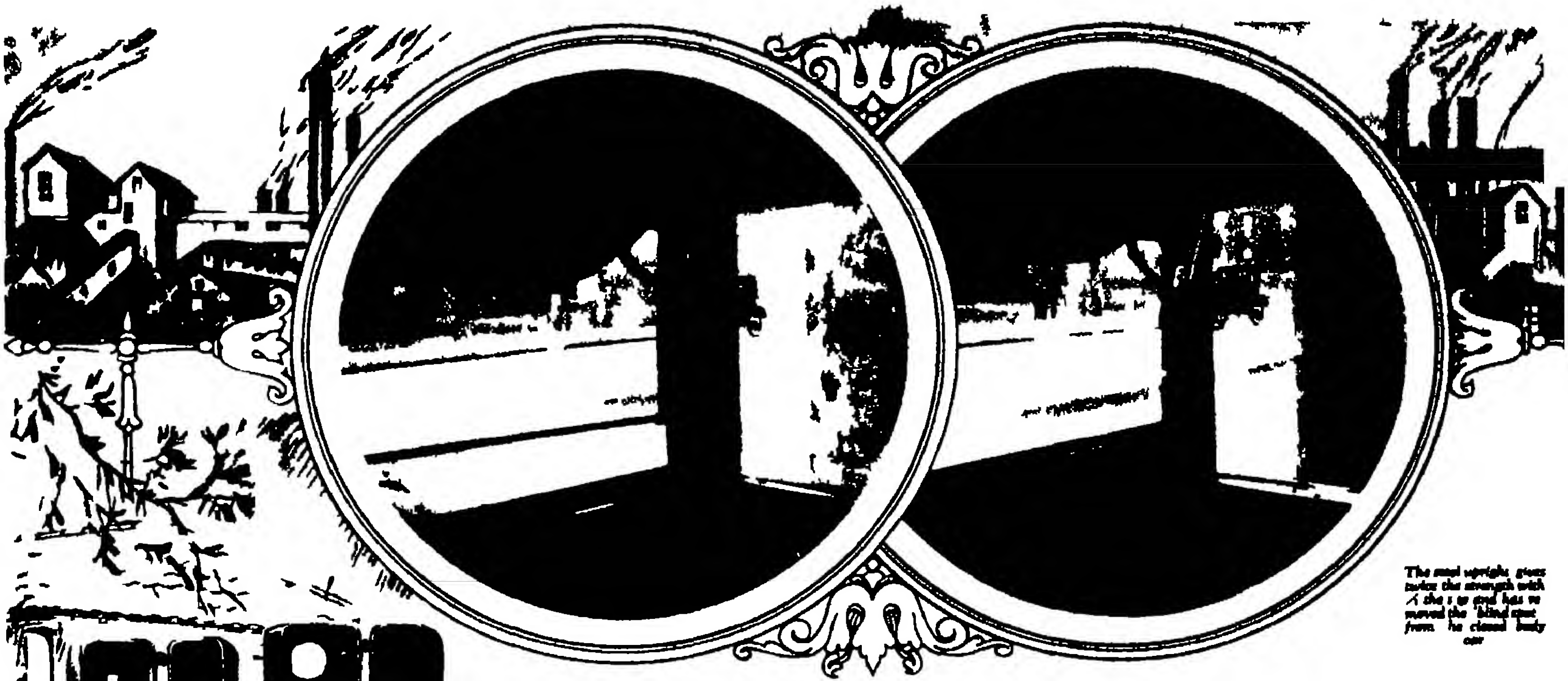
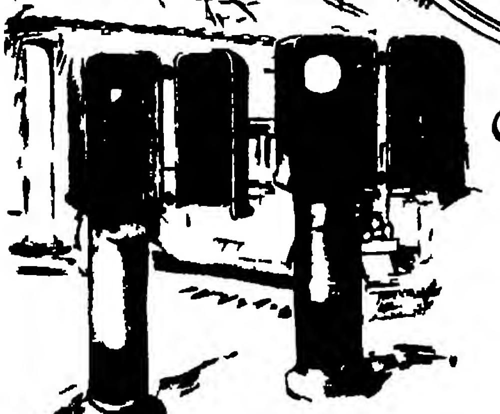


The steel upright gives twice the strength with ½ the s ze and has re moved the "blind spot" from he closed body car



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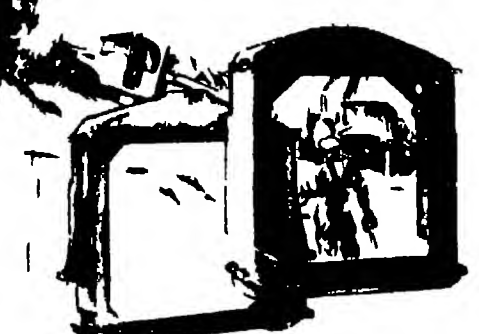

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Then someone thought of Sheet Steel

A Sheet Steel upright was designed which was twice as strong yet one third the size of the old type Experts today freely predict that the time is coming when the "blind spot" will be outlawed from the road

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SCIENTIFIC AMERICAN

THE MAGAZINE OF TODAY AND TOMORROW

NEW YORK, JULY, 1926 — *Edited by* ORSON D. MUNN — EIGHTY-SECOND YEAR

EXPANSION

WITH this issue the Scientific American becomes an eighty page magazine. Heretofore it had seventy two pages.

Why did we enlarge our journal? What motives?

Well, the real reason for the added pages is the fact that we have more things to tell you, about what is going on in the world of science and industry, than we can pack comfortably into seventy-two pages. The facts that the leaders of the world's thought are now writing for us are so important and so interesting that to trim these articles down so that they can be squeezed into seventy two pages necessitates a sacrifice that we are unwilling to impose on either our authors or our readers. Then, too, articles you would enjoy have had to be put off from one issue to another on account of lack of space

Oh, yes—the price? It remains the same.

$(9^9)^9$

LAST month we suggested to our readers that they figure out—and *write* out—the greatest number that can be indicated by means of three digits. A good many of them have made a fair start but nobody has sent us the correct answer as yet.

And there is a good reason why!

Nine to the ninth power, all to the power of nine, as expressed above, represents a number having some 369,-693,000 odd digits, more or less. If one were to write digits at the steady rate of sixty per minute, and work ten hours a day, the whole number would be finished sometime in 1954, according to M Laisant, of the *Ecole Polytechnique*, Paris

Suppose we were to publish the number in the Scientific American, and filled each issue entirely with digits. Our readers would have the full result in 31 years.

Sorry, but we refuse to do it.

PROTECTION

ALL hail the passage of the Webb-Loomis medical bill in New York State. If this bill is enacted into law, it should have a far-reaching effect in the medical fraternity and in the curbing of quackery. The bill provides for the annual registration of all practitioners with the State Board of Medical Examiners and for the prevention of the use of the title "doctor" in a misleading manner The registration lists will be open to the public at all times and so should prevent the gullible from being defrauded.

In This Issue

Who is Patience Worth?
That is one of the absorbing questions that must be answered before "The Riddle of Patience Worth," see page 20, can be solved. Read what Dr. Walter Franklin Prince has to say on this subject.

Whence Came the American Indian?
Careful researches conducted on the old stamping grounds of the Indians have produced no evidence that the race has long inhabited the plains and mountains of the Americas In an article on page 7, Dr. Ales Hrdlicka has presented some facts that point toward a solution to this problem.

"Hello, London"—"Are You There, New York?"
These may not be unusual phrases in the near future, judging by the results so far achieved in transatlantic radio telephony On page 30, Orrin E. Dunlap, Jr., tells how this is accomplished.

Does Moonlight Affect Plant Growth?
Old fashioned farmers would plant certain crops only when, according to tradition, the phase of the moon was auspicious Were they victims of superstition? Probably not, in view of the facts showing the relationship between polarized light and plant growth put forth by Prof H. H. Sheldon on page 10

The Atmosphere in Cross-Section
How high have sounding balloons been sent? How high do meteors flash? What are "noctiluscent" clouds, fifty miles up? How high is the aurora? What of Prof Goddard's "moon rocket"? See page 17.

MORE THAN 200 PICTURES

Complete table of contents will be found on page 80

For Next Month

How Earthquakes Are Located
The science of seismology is in its infancy However the promise of an early maturity is encouraging Today a chain of earthquake observatories encircles the globe In our August issue Father Francis Tondorf will describe how a seismograph records the tremors of the earth's surface

Golf Balls Studied Scientifically
The score that you make in golf does not depend entirely on your skill The construction of the ball used is of vital importance Prof H H Sheldon will show how the desirable characteristics can be determined experimentally.

Imagine an Island of Silver!
Catalina, an island off the coast of California, is now being intensely mined for its valuable ore, yet the mining operations are not interfering with the pleasure resort possibilities

Other articles on, The Jade of Mexico and Central America, The Salt Miners of Nevada, The Manufacture of Rayon, Training Parachute Jumpers, Conservation, Our New Airplane Carrier, the S S Saratoga, Radio, Astronomy

MORE THAN 200 PICTURES

COMPLAINT

DOUBTLESS, many of our readers will be sympathetically disposed to the statement of Mr T J Kennedy, Chairman of the Cold Rolled Press and Copper Association, when he makes a plea for the use of simple language in the reports of research workers Speaking at an annual luncheon in Birmingham, England, he said that some of these reports—though doubtless of great value—were, because of what he calls their scientific "jargon," as unintelligible to the average business man as they would be if they were addressed to him in Russian He objected to the tendency to "label a characteristic with some new name rather than to resolve it in terms of familiar conceptions" The terms used in scientific research are based largely—almost exclusively—upon Latin or Greek originals and hence this complaint should find a sympathetic hearing in this country, where there is a tendency to omit classical studies from the curricula of our schools and colleges

ROTORSHIPS

WE have just come from circumnavigating New York harbor in Herr Anton Flettner's famed rotorship *Baden-Baden* There is no doubt about it, the new vessel performs well But will it be an economic success? There is the crux of the matter, and there is no way to find out except to try one in actual commerce Purely scientific interest does not weigh much with ship owners Dollars do

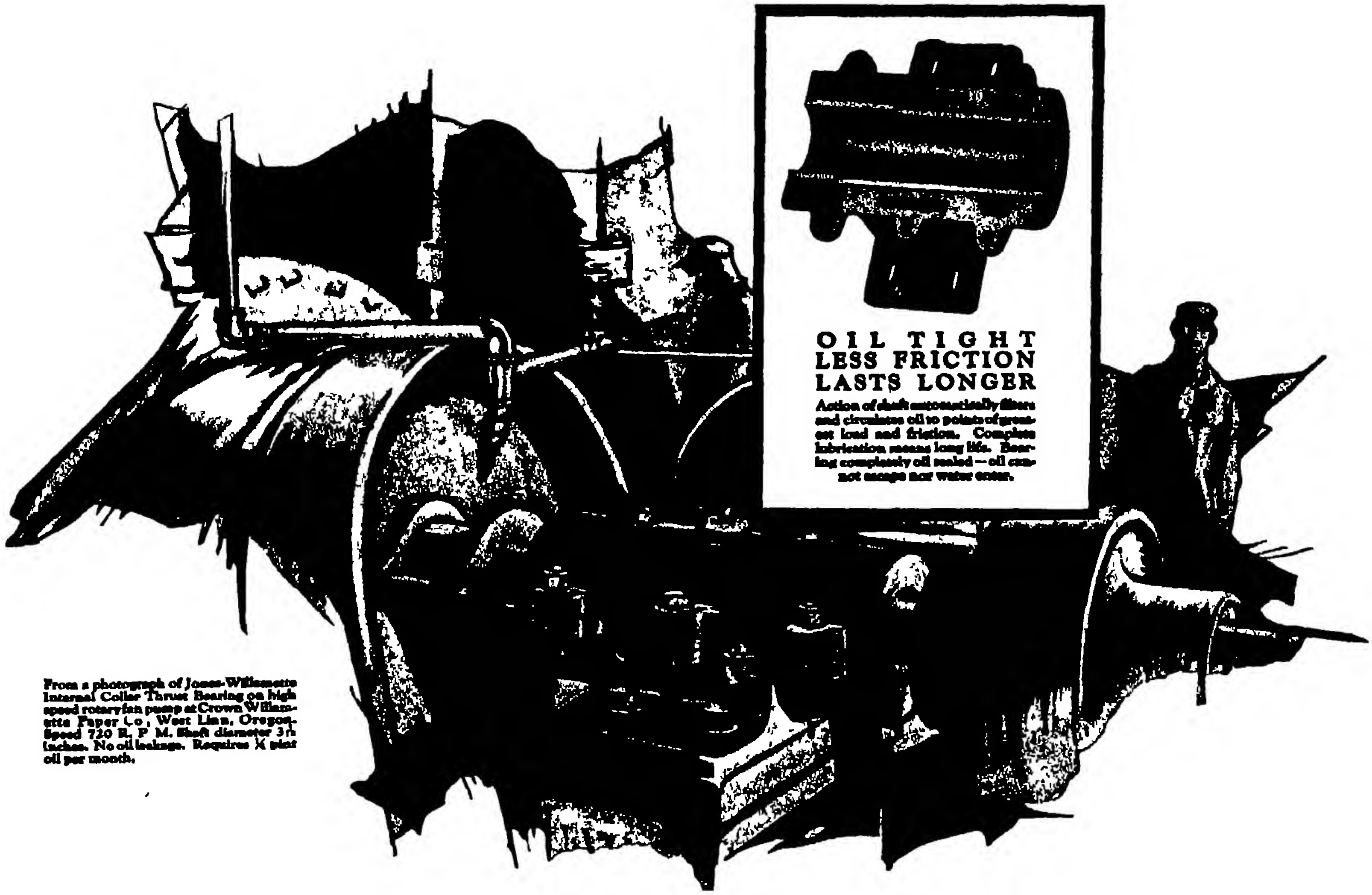
Many of the things that have been said about the rotorship do not apply Its inventor does not expect it either to supplant steam or bring a return to wind navigation It is itself to become an auxiliary to steam In that capacity it should save fuel

PLANES

PERFECT flatness is an ideal which scientists admit is almost impossible to attain However, the Bureau of Standards has come near it, producing a surface which deviates only one five millionth of an inch

This has been accomplished by producing a "master quartz flat" which, it is predicted, will supplant the glass flats previously used in testing micrometers and other gages used by manufacturers The fault of the glass flat, it is explained, lies in the fact that it is expanded by heat

This is only another one of innumerable cases in which industry has had to look to science for its own advances



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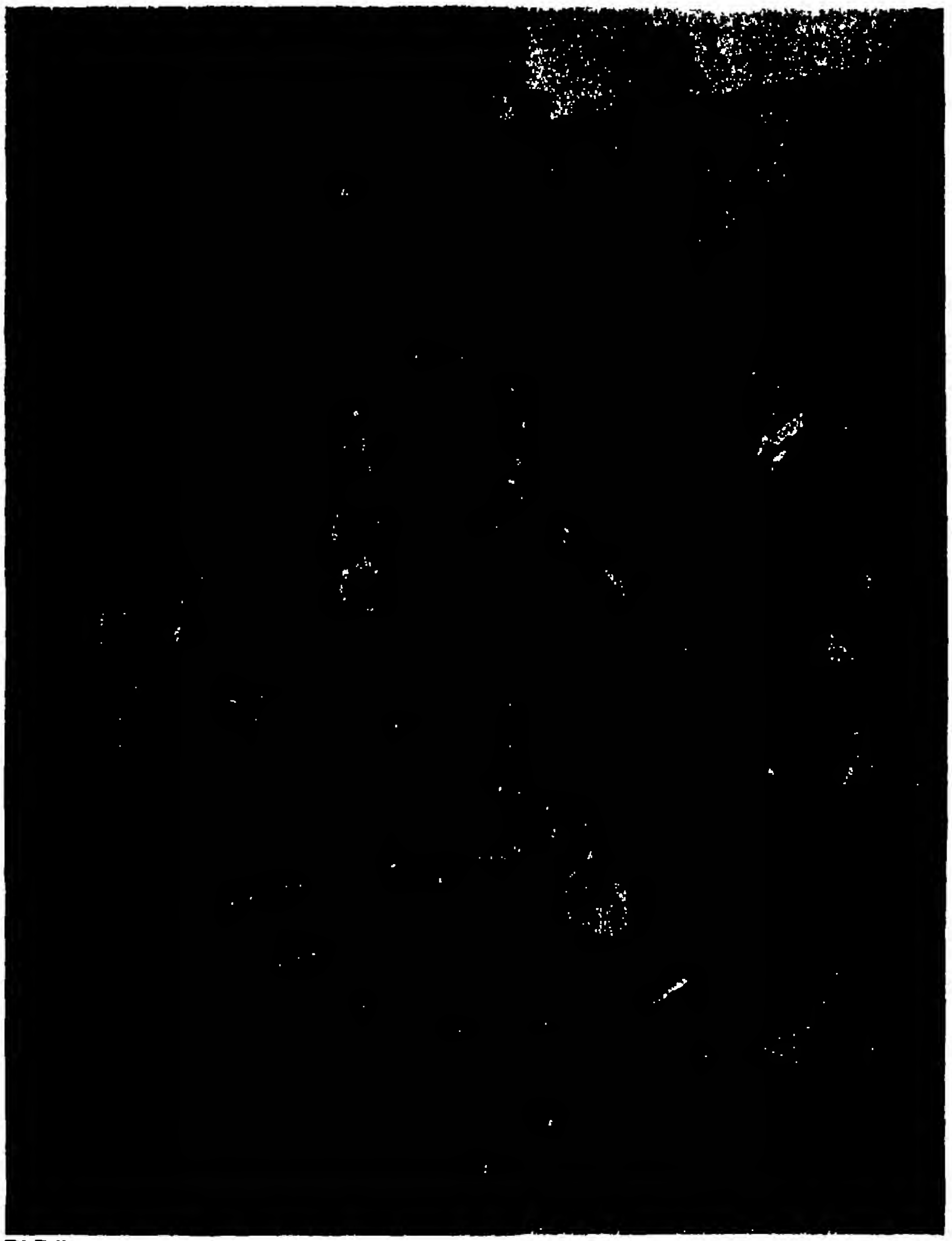
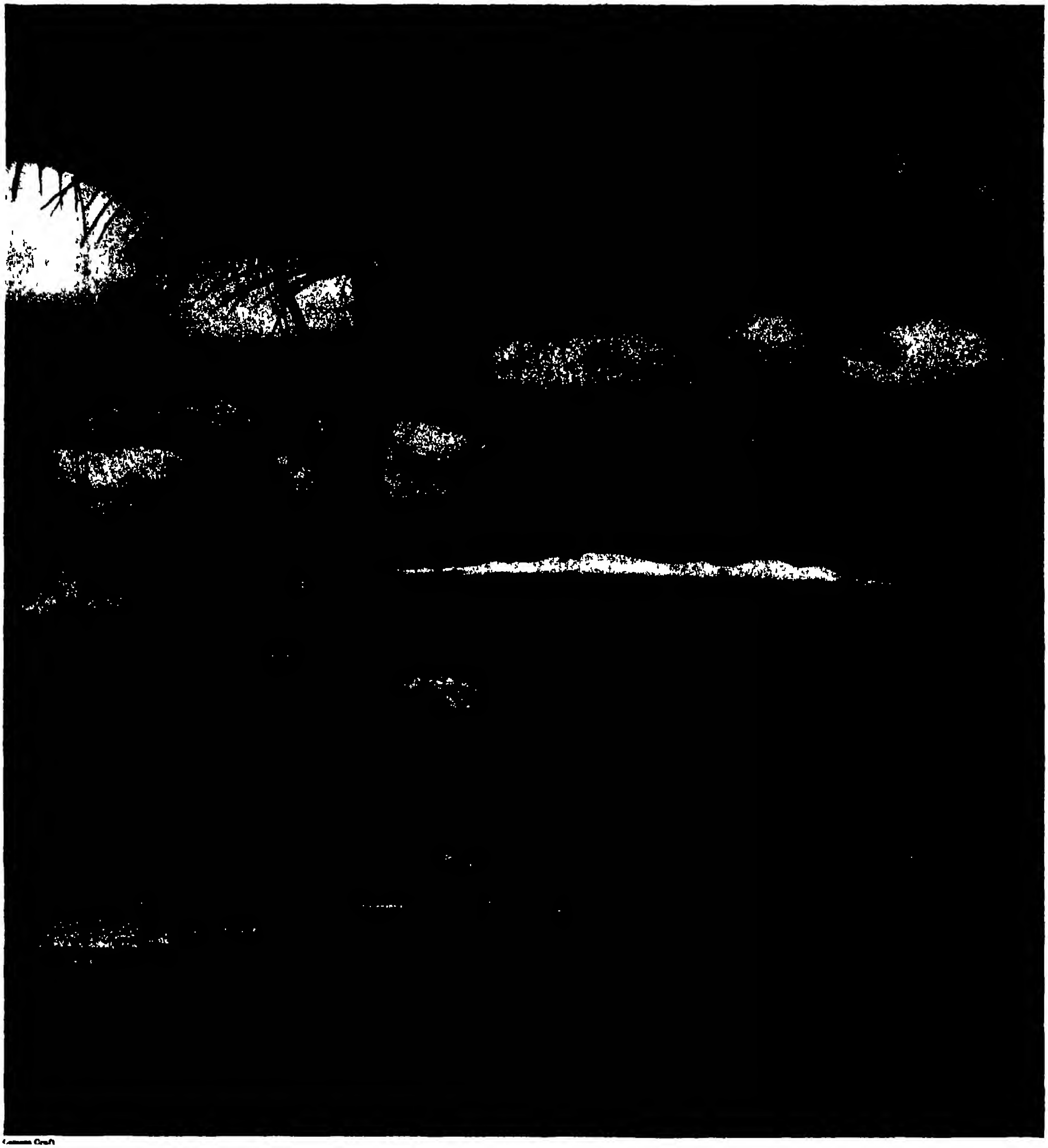


Wide World

HELPS TO IDENTIFY NEW ELEMENTS

For his notable researches in X-ray spectroscopy, Prof. Manne Siegbahn, Professor of Physics at the University of Upsala, Sweden, has been awarded the postponed 1924 Nobel Prize for Physics. His work permits us to measure the extremely short wavelengths in the X-ray region of the spectrum with much closer accuracy than ever before, while his study of the soft radiations that lie between the ultra-violet and X-ray region of the spectrum "have made possible," says NATURE *(London), "the theoretical work on which practically all our knowledge of the distribution and energy properties of the electrons in the atoms is based." This data led to the recent identification of three new elements. If the periodic law holds good, all but two of the elements have now been discovered.*



Camera Craft

Mauna Loa Active Again

Since 1919, the Hawaiian volcano, Mauna Loa, has been nearly dormant, showing only occasional sparks of life in the form of discharges of gases and bubblings of lava in the crater Recently, however, the formation of molten rock increased until finally it overflowed through a crack in the mountainside and a sluggish stream slowly wended its way toward the sea A volcanic eruption of this sort is not dangerous to the populace as the lava stream in this case moved at a speed of only about five miles a day, allowing ample time for the inhabitants to move from its path Much property was destroyed, but general economic conditions suffered little and in the majority of cases business continued.

Our illustration shows a view of Mauna Loa and Mauna Kea, a sister peak, as seen at a time of inactivity from the harbor of Hilo, Hawaii Mauna Lao, the left peak, is 13,695 feet high. In the illustration it appears to be much lower than this, due to the distant perspective and because the land surrounding it slopes upward gradually, a fact not apparent in the picture and one that is deceiving to the eye.

DR. HRDLICKA HAS MADE THE STUDY OF MAN'S ANATOMY HIS LIFE WORK

The Race and Antiquity of the American Indian

There Is No Valid Evidence that the Indian Has Long Been in the New World

By Dr Ales Hrdlicka

Curator of the Division of Physical Anthropology, United States Museum, Smithsonian Institution

WHEN Columbus and his followers reached the Antilles and later the mainland of America, they found both the islands and the land peopled in all their habitable parts. And they found them peopled by a variety of man that, while differing in details, showed, nevertheless, so much in common that they comprised him collectively under the term "Indian."

History tells that, as no mention was made concerning the American natives in the Scriptures, many of the early Spaniards, up to Las Casas' time, reached the conclusion that they could not be regarded as men equivalent to those named in biblical accounts. This view, which eventually had to be counteracted by a special papal bull, led to wholesale enslavement and destruction of the Indians.

The effect of the papal edict which established the American aborigines as true men was that thenceforth their origin was sought in other parts of the world, and the seeming necessity of still harmonizing this origin with biblical records led eventually to some curious opinions. One of these was to the effect that the American aborigines must be the descendants of the Canaanites who were expelled from their original abode by Joshua, another was that they were descended from Asiatics who themselves originated from Magog, the second son of Japhet; but the most widespread theory, and one with the remnants of which we meet to this day, was that the American Indians represented the so-called Lost Tribes of Israel Lord Kingsborough died in bankruptcy through costly publications in which he tried to prove this opinion

During the course of the Nineteenth Century, with Levèque, Humboldt, McCullogh, Morton and especially Quatrefages, we begin to encounter more rational hypotheses concerning the origin and racial identity of the "Indians," but the individual views differ widely For some the Indian is "autochthonous," that is, he originated somehow in the New World, while for others he has been wholly or partly derived from the Asiatics, or the Phoenicians, Egyptians, Ethiopians, the Welsh, the Irish or still others The erudite Dr. McCullogh believed that the Indians originated from parts of different peoples who reached America over lost land from the west, "when the surface of the earth allowed a free transit for quadrupeds." Quatrefages viewed the Americans as a conglomerate people, resulting from the fossil race of Lagoa Santa, the race of Parana, and probably others, in addition to which he believed that in Southern California and perhaps elsewhere there had been settlements of Pacific Islanders. Nevertheless, the majority of the authors of the last century believed that the American natives were all of one main race and that they were derived from northeastern Asia, particularly from the "Tartars," or Mongolians.

Opposing Theories About the Indian

The most recent students of the question agree that this country was peopled through immigration and local multiplication of people, but the locality, nature, and unity or plurality of the immigration or immigrations are still moot questions While most students incline to the exclusively northeastern Asiatic origin, others, such as the French ethnologist Rivet, show on linguistic grounds a tendency to follow Quatrefages in attributing at least some parts of the native American population to Melanesians, Polynesians and even Australians.

With the general conviction that the Indian was an immigrant into the New World, there necessarily followed speculation as to his antiquity on this continent, and there were always, and are today, many who believe that man must have been in America a great length of time Such a notion is stimulating and therefore attractive Moreover it seems to be substantiated by the great diversity of the American languages, and by various finds which appear to point to man's co-existence here with extinct animals Charcoal, arrow points, fragments of pottery and even human bones have been found in association or in the same strata with the bones of the mastodon, fossilized buffalo, the glyptodon and other extinct creatures, or again in deep deposits of apparently great age

Moreover there are found from time to time human skulls and bones that have been petrified and even enclosed in rock And there are the many unquestionably ancient relics in other parts of the world to which, some students feel, there ought to be some parallel in this hemisphere It is little wonder that under these circumstances a belief in the geological antiquity of man in America should be found even with some reputable scientific men, particularly some of the older and again of the young generation, and among workers in collateral lines such as linguistics, geology and paleontology

The actual status of opinion as to the Indians' origin, racial composition and antiquity on this continent, may briefly be summarized as follows

1 The Indian originated outside of this continent and is therefore an immigrant into it On this point there is no longer any division of opinion

2. As to his racial composition there are two main views The more general one is that the In-

dian, notwithstanding the long-recognized presence among him of several more or less distinct types, is nevertheless essentially of one race, the yellow-brown, whose old home was northern Asia. A secondary opinion, spreading most recently again from France and finding here and there individual protagonists, is that the American man, while he is mainly of north Asiatic and yellow brown descent, comprises also various other racial contingents, from the Pacific, from Australia, to which some feel inclined to add Europe and the region of the Mediterranean These latter opinions are supported on one hand by apparent or real resemblances of linguistic character, and on the other by similarities of some American with other crania

3 As to the antiquity of the Indian in the New World, there are also two lines of opinion The first and more general is, briefly, that such antiquity is moderate and post glacial, the other, which is but hazily defined, places the coming here of man farther, and at times very much farther, backwards. The explanation of this diversity of views is relatively simple It depends partly on the peculiarities of human nature and partly on differences in training, but in the main on the varying individual degrees of knowledge and experience.

The Indian a Recent Immigrant

Let us take a rapid glance at the principal facts which have a bearing on these problems, considering first the racial question and then that of antiquity

In the racial problem the main word belongs naturally to physical anthropology which deals with the least mutable parts of man, namely his body and skeleton Our knowledge of the Indian has now advanced so far that a number of important generalizations concerning him are possible There are now at our disposal for comparison, in American museums alone, upwards of twenty thousand Indian crania and skeletons from all parts of the continent.

In the light of present knowledge concerning the American native, what can be stated with a fair degree of positiveness is that, first, there is no biological evidence or any probability, that man originated on this continent, second, that man did not reach America until after he had attained a development superior to that of even the latest glacial (upper Neanderthal) man in Europe, and after having undergone advanced stem and even racial and tribal differentiation; and third, that while the American man, since the peopling of this continent was initiated, has developed here numerous secondary subracial localized modifications, these modifications have in no basic feature obliterated the original general or stem type.

Notwithstanding the presence of several subtypes and various secondary physical modifications, the American Indian presents certain fundamental features in common which mark him plainly as of one race, in a broad sense of the word. These features are

The color of the skin The color of the Indian differs, according to localities, from yellowish brownish to that of the brown of solid chocolate, the basic color is brown

The hair of the full-blood Indian from one end of the continent to the other is black and straight, his beard is scanty, especially on the sides of the face, and is never long There is little or no hair on the body except in the axillae (armpits) and on the pubis, and even there it is sparse The hair is invariably black from birth on

The eyes as a rule are dark brown. The conjunctivae are blue in childhood, yellowish in adults. The eye slits show a prevailing tendency, which is more or less noticeable in different tribes, to a slight slant, that is, the external corners are frequently appreciably higher than the internal But the epicanthus (fold over the inner corner of the eye), while frequent in childhood, disappears later in life. The supraorbital ridges (above the eyes) are on the average more developed than in whites, but the glabella (space between the eyebrows) is not prominent or bulging and does not overhang the nasal root depression as in the Australian

The nasal bridge in the men is well developed, and the nose in the living, as well as the nasal aperture in the skull (barring individual exceptions), tend to medium relative proportions. The important detailed features of the nasal aperture and spine are of the type that prevails in the yellow brown stock. The malar (cheek bone) regions are as a rule larger or more prominent than they are in civilized whites

The mouth is rather large, the lips medium to somewhat fuller than in whites, the alveolar region (the parts of the jaws in which the teeth are set) are somewhat more prognathic, or protrusive. The lower jaw is strong, chin well developed, teeth frequently larger than in whites. The upper incisors of the Indian throughout the continent are characteristically "shovel-shaped," that is, deeply and peculiarly concave on their lingual side. The ears are large.

The neck is never long and thin. The chest is deeper than in average whites. The breasts of the women are regularly of a good medium size and generally more or less conical in form. There is a complete absence of steatopygy, or excess development of the buttocks. The lower limbs are less shapely than in whites, the calf is smaller.

The hands and feet, as a rule, are of relatively moderate or even small dimensions and, what is among the most important of the characteristics, the relative proportions of the forearms to arms and those of the distal parts of the lower limbs to the proximal (or, in the skeleton, the radio-humeral and tibio-femoral indices) are in general, throughout the two parts of the continent, of similar average values, which differ from those of both the whites and the negroes, standing, like so many other features of the yellow brown stock, in a more or less intermediary position.

Other Comers Assimilated

The Indian is free from characteristic odor. His normal heart-beat, except possibly in some parts of the tropics, is slow His mental characteristics are much alike. The size of the head and of the brain cavity is comparable throughout, averaging somewhat less than in white men and women of similar stature

This list of characteristics which are shared by all the American natives could be further extended, but the common features already mentioned should suffice They speak convincingly for the fundamental racial unity of the Indians.

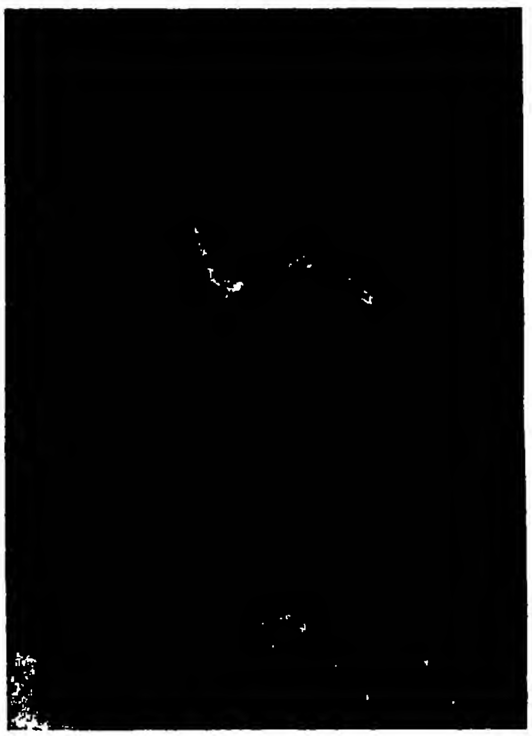
In this general Indian type there are, it may be reiterated, group, as well as individual, differences in color, stature, head form and facial features. But these differences are no greater than those that are found in the white race, or in the rest of the yellow-browns or in the blacks, and they are always

Whence Came the Indian?

He came from eastern Asia, says Dr. Hrdlicka, the author of the accompanying article, and he arrived in America comparatively recently, that is, within a few thousand years—and not, as many would have us believe, hundreds of thousands of years ago.

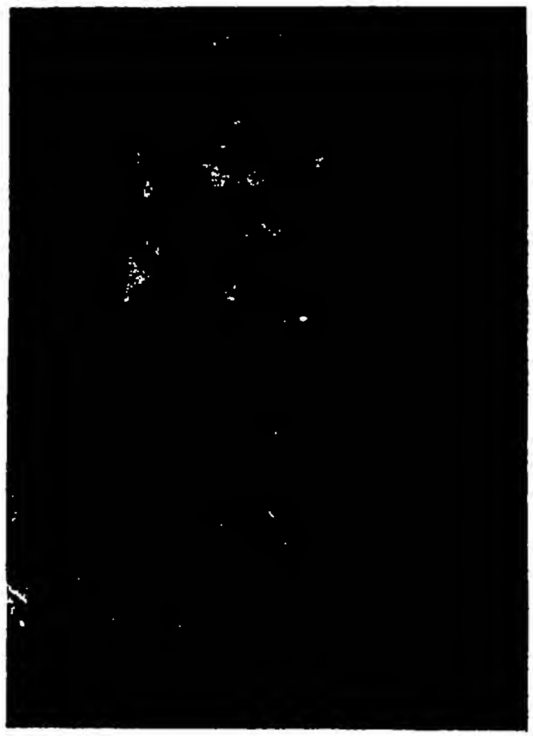
Dr. Hrdlicka is one of the foremost anthropologists of the world. In his capacity as head of the department of anthropology at the Smithsonian Institution he has time after time demolished unwarranted claims for the extreme antiquity of man in America.

In recognition of his important work the coveted Huxley Medal has just been awarded to Dr. Hrdlicka, and he will therefore go to England to receive this honor, and to lecture before the Royal Anthropological Institute.



BHUTIA WOMAN DARJEELING, NEAR TIBET

Of Mongoloid stock, she resembles the American Indian, in facial and other physical characteristics, yet her home is many miles from America



TIBETAN WOMAN FROM THE HIMALAYAS

Her face and features are those of a typical Apache Indian of the American continent Her ancestors probably immigrated via a now sunken land

IS THIS AN AMERICAN INDIAN?
One might easily think so, yet he is a southern Tibetan

associated with numerous other characteristics that brand every American aborigine indelibly as an "Indian." In no place and at no time has a normal, full-blood Indian been found who was or could be claimed as anything else than an Indian.

If the unmixed American aborigine is considered on the basis of all the data, both on the living and on the skeletal parts, the only conclusion that appears possible is that, though presenting a number of subtypes and a good range of individual or localized differences, yet fundamentally he belongs to but one large strain of humanity This is the yellow-brown stem, which includes the Mongol, the Malay, the Eskimo, with a large element in the Chinese, Japanese, Tibetans and the aboriginal Siberians, and more or less of whose blood runs also in the Polynesians.

This does not mean that there have been no accessions to the American stock in pre Columbian times. It is well known that long before Columbus some Scandinavians reached Greenland, and after that reached the "Vineland," which was probably the coast of New England It would also be hard to believe that no isolated vessels have in the course of ages reached the continent from other parts of the world, both across the Atlantic and the Pacific But such necessarily small parties of men, while capable, if preserved, of influencing a local culture and possibly even the language, would soon disappear through amalgamation and after a few generations would leave no substantial trace of their coming.

So much as to race We may now consider the question of antiquity

The criteria of antiquity, in the case of man, are in the main: Adaptation and diversification, and remains of the earlier man—remains of the animals on which he fed, of the stone and other utensils he made, of the refuse of his stone industry, of his fires and habitations, of his higher arts, and finally those of his own skeleton There are endless examples of all this in the Old World, particularly in Europe. There are whole "cemeteries" of the bones of mammoths (Moravia), of the ancient horse (Solutré), of the buffalo, reindeer, etc. (southern France) The sites of ancient man in western and parts of central Europe are so numerous that they can hardly be numbered. The industrial (stone implement) remains of early man in France alone are rich enough plentifully to supply all the museums of the world. Individual sites in England, the Channel Islands, Belgium, France, Spain, Moravia, have given prehistoric implements and rejects reaching up to tens of thousands, and there is no old cave in the regions occupied by early man that does not yield evidences of his presence ranging from substantial to rich. Besides which there is not now a year in those parts of the world but there are discovered the skeletal remains of man of antiquity himself, remains which, except in the latest and postglacial phases of prehistory, show a man progressively, as we go back in time, of more primitive features.

Let us contrast America Not a single skull or skeleton of a lower or other type than that of the Indian Not one cave with old art on its walls, not one to this day that has shown the presence of pre-Indian habitation Not a single refuse heap or habitation site with ancient bones or implements. Notwithstanding the life works of Putnam, Thomas, Clarence B Moore, Holmes, Fewkes, Hough, Morehead, Mills and many others, not a scrap of a bone or implement that can generally and with full confidence be accepted as geologically ancient Also not a single discovery by non anthropologists that has so far stood the test of critique or that can show more than Indian-like implements, Indian-like pottery, Indian-like skull or bones, or such an association with *really* old animal remains that could definitely exclude the possibility of chance

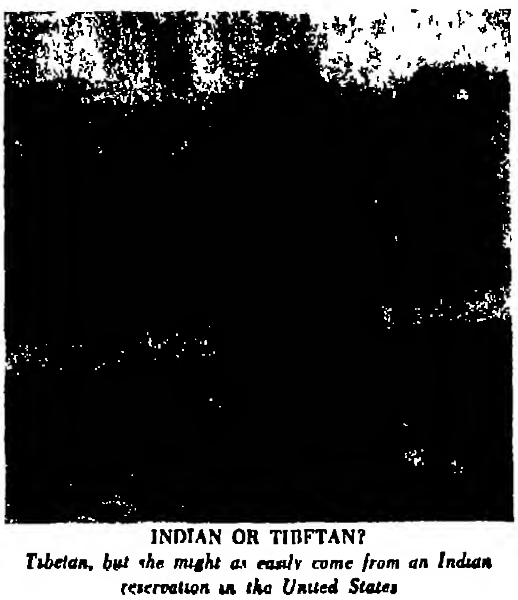
It is self evident that if man had existed on this continent during the glacial times or before the Indian, he would have been here in numbers, and being gregarious he would have lived in groups But a family or clan or a tribal group, even if nomadic, is bound to leave ample witnesses of its existence in the form of refuse, of animal bones, of stone workings, if nothing further Where are these witnesses in the New World? And aside, how could man have reached here during glacial times? Where are his traces on the road, and in eastern Asia? What could he have been derived from, and what has become of him?

Sources of Error

It must be evident even to the non scientist that not until all these questions can be satisfactorily answered may American science accept as a fact the presence here of any geologically ancient (glacial or pre-glacial) man, preceding the Indian, and they are not being answered

As to the coming of the Indian, it could have been no regular, stream immigration, but only a dribbling over from northeastern Asia, extending probably over a long stretch of time; and the successive contingents must necessarily have brought with them differences in language and even in physique, which doubtless account for at least a certain proportion of the Indian linguistic stocks, as well as for several of his more marked physical types.

As to the antiquity of the Indian himself, that cannot be very great. He has passed here through



INDIAN OR TIBETAN?
Tibetan, but she might as easily come from an Indian reservation in the United States

ANOTHER INDIAN TYPE FROM TIBET
Replace his queue with feathers What would you call him?

no gradation of cultural stages. He has become differentiated here into no markedly different physical groups geographically, notwithstanding the fact that he extends from the arctic to the tropics and again to the antarctic, and from the high sierras to the low sea coasts Throughout he presents a stage of physical development that belongs to the era of post glacial and recent man And scattered over a large part of eastern Asia, he still has living relatives who are still so close to his type that if they were mingled with him and dressed in his way they could not possibly be separated as something different

That Indian bones, potsherds or implements have been found in greater or less of association with bones of the mastodon, the giant armadillo and other extinct animals, may readily be conceded That they will be found in such associations even more frequently in the future, if excavations extend, is certain But such association alone is of doubtful value It is not yet known just how late some such animals survived but regardless of their antiquity, the presence with them or even beneath some of them, of human remains does not necessarily mean contemporaneity Here is where many are misled Except in secondary accumulations an animal bone found with another animal bone may safely be assumed, in the majority of cases at least, to be of the same age. But with human remains, particularly human bones, there enters into the case a most important, most disturbing and practically constant factor, which is human instrumentality Since the early Neanderthal times, at least, man has *buried* his dead, or what may have been left of them after temporary exposure And he buries two to seven feet deep, into any strata that he can penetrate In this manner he introduces his remains into different associations, and bones of fossil forms may even come to lie above the human Hundreds of years of settling, brought about through seepage and other processes in the ground, will in many cases obliterate the disturbance, due to the components of the soil or waters, the bones may meanwhile fossilize more or less, in the same manner as older inclusions, and thus the trap is beautifully set for another "tertiary" or "glacial" man in the eyes of the more enthusiastic than experienced and wary observer

Taking everything into consideration we may therefore still hold legitimately that the presence on the American continent, north or south, of beings older than or different from the Indian, has not been established, and that according to all indications the antiquity here of the Indian himself is moderate, post glacial and probably post-Aurignacian

Polarized Light and Plants

Preliminary Research Traces an Apparent Connection Between Moonlight and Plant Growth. More Research Is Needed. The Amateur Can Help Perform It

By Prof. H. H. Sheldon, Ph.D.

Chairman of the Department of Physics, Washington Square College, New York University

IT is seldom that so attractive a field of research for the amateur is opened up as that which has been introduced by the findings of Miss E. S. Semmens, an English botanist, on the effect of polarized light on the germination of seeds and the flowering of plants

Informed by an old gardener that seeds sown in the full of the moon germinated more quickly than those sown in the dark of the moon, she sought to verify these results and was successful Obviously, since sunlight is perhaps on the order of 600,000 times as intense as moonlight, there must be some other explanation of this phenomenon than the intensity factor

On the average, moonlight is about ten percent "polarized" If this is the cause of the more rapid germination of seeds and flowering of plants, the test can be made in the laboratory, using such light Such tests have already proved the correctness of the assumption, and this success in turn has led to many other similar tests on the behavior of sea animals, on the growth of bacteria and other related phenomena.

Before attempting to outline the procedure in our experiments, we must first have a clear idea of the nature of polarized light

To transfer energy from one place to another through space, there are but two methods, projection and wave motion For example, you may tear a hole in the side of a ship by sending a torpedo or shell against it, the energy is carried in the form of a material body. Or you may likewise damage the ship by creating large waves on the water All other cases may be reduced to one of these two categories. Although contrary theories of light exist, it is simpler to think of light as being formed by waves, since the distance from the sun to us seems a long way for particles so small that they are invisible, to travel and still be able to produce phenomenon of light

A PRISM THAT POLARIZES LIGHT

FIGURE 1 *This natural crystal of Iceland spar has been sawed in two diagonally and cemented together again with Canada balsam In addition it has had its end faces shaved off at an angle of 68° to the side*

Such waves would not, however, be on the surface of anything, that is, they would be more like waves *in* water rather than *on* it, so that there would ordinarily be no "up and down-ness" to them Instead, they would vibrate in every conceivable direction across the line of progress. A string of fuzzy Christmas-tree tinsel, held taut, might be used to illustrate this phenomenon. In the analogy, the direction of progression of the waves would be along the length of the string, while the direction of their vibration would be shown by the particles of tinsel sticking out in all directions Now if you were to press this tinsel out flat with a flatiron, it would form an illustration of polarized light, whose vibrations are all in *one* plane This is the kind of light we need in order to perform our experiments on plants.

Polarized light can be obtained by sending ordinary light through a Nicol prism such as that shown in Figure 1. Such a prism, if of practical size, is not only very expensive, but is also difficult to obtain, so that it is ruled out for the average amateur The one shown in the figure is about 1½ inches across and is valued at several thousand dollars. Excellent results can, however, be obtained by reflecting ordinary light at what is known as the "polarizing angle," from a piece of plate-glass, or better still, from a pile of such plates. The polarizing angle depends on the kind of glass used, but in general, it is safe to take the angle somewhere between 55 and 57 degrees. With the arrangement shown in Figure 2, the reflected light will be largely polarized, while transmitted light will be partially polarized and can be made almost wholly so by using about ten such plates held together

Any experiment using polarized light is valueless unless a control experiment using equal intensity of ordinary light is carried on at the same time A second control experiment should also be carried out in total darkness, so that it can be certain that the light is really the cause of whatever effect may be observed. This necessitates either considerable precaution in arranging the lights to begin with, or the measurement and adjustment of their intensity when used.

With the first idea in mind, it is best to use sunlight as the source Arrange a pile of glass plates as shown in Figure 2a and place beside it a control pile, as shown in Figure 2b. The total thickness of glass should be the same in each case so that there will be the same absorption loss. The reflection loss at the top plate is approximately the same in each case; and although there is some polarization at the top plate of Figure 2b, it is small compared to the polarization effected by all the tilted plates in Figure 2a

The great difficulty when employing sunlight is

All photographs made for the Scientific American by Brown Brothers

POLARIZED VERSUS UNPOLARIZED LIGHT

FIGURE 2 *The diagrams here show how illumination of approximately the same intensity may be obtained yet the light is polarized in one case and only slightly so in the other*

PUTTING THEORY INTO PRACTICE

FIGURE 3 *The diagram illustrates the use of a large condensing lens to render rays of light parallel The apparatus on the table shows such a system about to be put into operation*

HOW THE PHOTOMETER IS USED

FIGURE 4 *The apparatus in the foreground is a photometer in use to measure the relative intensity of the two lamps shown at either end. Almost above the box in the picture is a diagram showing the box and interior arrangement. Figure 4a shows how the box is dispensed with and a greased paper used between the sources*

A PHOTOMETER OF VARIED USES

FIGURE 5 *The instrument here shown in use is a very elaborate type of photometer called a spectro-photometer. It can be used not only to measure relative intensity of illumination but also to measure the relative intensity of each of the colors which go to make up the light from any two sources and so allow comparisons*

to keep the plates at the correct angle with the sun as it progresses from east to west. However, an ingenious person can arrange an old clockwork to do this job for him. Perhaps it is easier to use artificial light, even though this necessitates a large condensing lens to render the rays parallel in order that they may all strike the glass at the correct angle. When such rays are parallel, they should form a round spot of light about the size of the lens itself on a distant wall (Figure 3). Obviously, a large lens is necessary, but it does not have to be an expensive one. Large condensing lenses such as those used in projection lanterns can be purchased cheaply.

If it is desired to adjust the intensities of the light more accurately, this can be done very easily. Make a grease spot on a piece of white paper and reflect the light of each beam (the polarized and the unpolarized) against opposite sides of the paper by means of mirrors held midway between them (Figure 4a). If, when looking at it from the polarized side, the spot looks brighter than the rest of the paper, then the polarized light is the less intense. If the spot looks darker, the reverse is the case. The adjustment can be made by adding more glass plates or, in the case of artificial illumination, by adjusting distances from the source.

Care must be taken to prevent light from reaching the paper from any other source in the neighborhood. This may be accomplished by a screen, as shown in Figure 4a, or better still, by enclosing the paper in a box having mirrors inside to reflect a view of the paper, and holes at either side to allow the light to enter, as shown diagrammatically in Figure 4b. Such an arrangement is called a photometer.

With our apparatus arranged, we are ready to start the experiments of various sorts as best suits our own fancy.

If it is desired to test the germination of seeds, it does not matter particularly what kind of seeds are used. Such seeds as mustard, water-cress and sunflower are very useful, however, as the percentage of successful germination is rather high for all of these. For rough experiments, these can be placed in two dishes filled with soil of the same kind, or even in the two halves of the same box and separated by a card in order to keep stray light coming from one side from reaching the other. As reflected light is always more or less polarized, it is desirable to prevent it from reaching this box from any source. Consequently, such a card should be black and rough so as to give little reflection.

If really careful work is to be done, soil of any sort is not desirable, and should be replaced by a nutrient solution. A nutrient solution may be made as follows: potassium dihydrogen phosphate, KH_2PO_4, 20.4 grams, calcium nitrate, $Ca(NO_3)_2.4H_2O$, 18.9 grams, magnesium sulphate (Epsom salts) $MgSO_4.7H_2O$, 19.7 grams, sodium chloride (common salt) NaCl, 2 grams, ferric phosphate, $FePO_4$, 2 grams, water, H_2O, 10 liters.

Any chemist can put up this solution for you, or you can prepare it yourself. If you have no convenient way of measuring grams and liters, you can change to ounces and quarts by computing on the basis of 28.35 grams to the ounce and 1.057 quarts to the liter.

> **Superstition—or Science?**
>
> **Science has always scoffed at the "old wives' tale" about planting seeds by the moon's phases. Recently, however, a British scientist showed that the germination of seeds and the flowering of plants are hastened by the action of polarized light and that moonlight *is* (partly) that kind of light.**
>
> **Before we fully understand these matters, more research is required. Much of it can be done at home, by the amateur scientist. It requires some seeds, a few small pieces of plate glass, some other odds and ends, and sunlight. It invades the interesting fields of physics, chemistry, biology, botany and bacteriology. In the accompanying article, Professor Sheldon tells you how to do the work.**
>
> **Perhaps the old-fashioned farmer who planted his crops "in the moon" was about right. But he did not understand why. It is the discovery of this "*why*" that is the most interesting part of this or any other piece of research.**

Such a solution is now to be used for soaking cotton batting or filter paper placed in a flat, shallow dish. On this the seeds are placed. The whole may be covered with glass in order to prevent outside moisture, dust, and so on, from entering. The time required for germination can then be carefully noted, for the seeds are at all times visible. After germination has occurred, no difference in the rate of growth of the stem or leaves will be noted (according to experiments so far performed). If, however, such plants are allowed to reach the flowering stage, those in the polarized light should be favored in growth rate.

If one takes into consideration a large number of experiments which have been carried out on plants at the Boyce Thompson Institute for Plant Research, it will be seen that different kinds of plants react in a very different manner under the same artificial conditions of illumination, atmosphere, pressure, and so on. It is, therefore, obvious that one cannot at the present time predict from experiments on one plant what might take place with another.

The most recent work of Miss Semmens has been carried out on the hydrolysis of starch grains. This was done with great care. It necessitates the use of a microscope, sensitive thermocouples for intensity regulation and other expensive equipment. Thus, it is a bit beyond the means of the average amateur. In any case, this research is already being well done while the actual work of a more practical nature on plants is at present more or less neglected.

Among the other effects apparently due to the partially polarized light coming to us from the moon, may be mentioned a recent investigation by H. M. Fox (*Discovery*, London), who has shown that the sea-urchin of the Red Sea increases in size at the full of the moon, a period which coincides with its reproductive activity.

The effect of polarized light on the putrefaction of fish was first announced by E. G. Bryant, who found that pieces of fish exposed to moonlight became putrid much more rapidly than similar pieces left in the dark. More recently, G. F. Morrison has experimented on the effect of polarized light on the growth and luminescence of luminescent bacteria in fish and has reported a marked increase under polarized light.

It will be seen from this article that the field of biological research with polarized light, extending as it does from the acceleration of the flowering of beautiful plants to the putrefaction of fish, offers a wide field indeed. Further, the fact should not be overlooked that no explanation of the effects which have been observed have been given, and probably will not be until a great deal more work has been done.

Lunatics were originally so called because they had supposedly been affected by the moon. Those who thought so may not have been quite so crazy, after all.

Our Point of View

"GARABED" is a new word which bids fair to enter the language. A definition of it might be "scientific hokum in support of which political pressure is brought to bear."

Perhaps you have forgotten about Garabed. Let us refresh your recollection at this time, for its originator recently has received a partial approval by Congress for a most astounding proposition.

"Garabed" is the name Garabed T. K. Giragossian, an Armenian resident of Boston, gives to his alleged "free energy generator" or illimitable source of power. Eight years ago he succeeded in having Congress pass a measure agreeing to give him extraordinary privileges if he could prove his claims.

His claim is that he has devised means to utilize energy without limit and at no cost except for the usual depreciation of machinery. He says that with his device unsinkable ships will cross the ocean in thirty hours, airships will float in the air through the neutralization of gravity, and every farmer will burn nitrates from the air with costless electricity.

The war was on eight years ago and Congress passed his measure, for "Garabed" promised to end the war promptly and forever. A commission of five scientists was appointed for a demonstration. As a result of that demonstration, the Scientific American reported as follows:

"And so, after all, it turns out to be nothing but our old friend the flywheel and its family of pulleys, that will o'-the-wisp of the perpetual motion crank. We, ourselves, had expected that investigation would disclose an ingenious bit of mechanism, but it had not occurred to us that 'Garabed' would prove to be one of the typical perpetual motion schemes of the well-known type pursued by men who do not know the difference between power and force.

"The machine consisted of a heavy flywheel which could be set in motion by means of a system of pulleys. The flywheel was mounted in bearings in which friction was reduced to a minimum, and it was furnished with a form of electric motor driven by a small storage battery. The inventor claimed that the machine would start itself, but that it would take a very long time to run the flywheel up to full speed, and so it was started by a strong man by means of the pulleys and belts. After the machine was started, the battery was switched in and the machine would continue to rotate indefinitely.

"Apparently it took only one twentieth of a horsepower in the electric motor to keep the machine running, and it took 10 horsepower to stop it, so that the inventor believed he was actually producing energy. Evidently he was not possessed of even an elementary knowledge of physics, such as a boy acquires in high school, or he would have realized the difference between force and power. It should be perfectly apparent to him that the energy stored up on the flywheel was that put into it by the man. All that Mr. Giragossian did after running his machine for a time was to stop it suddenly and note how great a power was developed by expending in a few seconds the energy which it had taken minutes to store up."

Now again Giragossian is demanding a patent on this ridiculous device. This time he asks more than he did before. He wants not only a patent monopoly, but to be relieved of the necessity of proving that he is the first or original discoverer.

The natural question is, why does he not apply at the Patent Office? Because he is afraid somebody will steal his invention, he says, and that it will be the beginning of long and costly lawsuits. Upon that alleged reason the Scientific American on August 31, 1918, made the following comment:

"Such an attitude should have been discouraged, but Congress by its unprecedented attentions, actually fostered these suspicions and cast a slur upon regular legal means of protecting inventors which are provided by the Patent Office. Had Mr. Giragossian applied for a patent in the usual way he would have been shown very promptly by the Patent Office the fallacy of his reasoning."

We repeat that comment now, with this addition. For Congress to lend an ear to Giragossian's fantastic scheme establishes a dangerous precedent. It opens the door to any charlatan who seeks to ignore the orderly process of government. Let Giragossian apply to the same bureau where real inventors apply and where politics will have no influence.

At Last!

Throughout the later years of arctic exploration, it has been the dream of the explorer to fly to the North Pole, and also to unlock the secrets of that vast area which lies between the Pole and the northern coasts of Alaska and Siberia. The successful accomplishment of both of these hazardous undertakings will render the year 1926 memorable forever in the annals of arctic exploration. To Lieut.-Commander R. E. Byrd, U. S. N., fell the honor of being the first man to reach the Pole by airplane, which he did in a continuous flight of 1,200 miles in an all-metal, multi-engined monoplane, starting from Spitzbergen and returning to the same base.

To that veteran explorer Amundsen, assisted by the American, Ellsworth, and the Italian, Nobile, the designer of the ship, it was given to fly in an Italian-built semi-rigid from Spitzbergen to the Pole; onward to Point Barrow on the Alaskan Coast; and thence to Teller, near Nome, in a continuous flight of 2,700 miles, lasting 71 hours, in the latter part of which he fought his way against fog, ice and blustering winds. This magnificent flight of 6,820 miles from Rome, over the Pole to Alaska, has served, as nothing else could, to restore the waning prestige of the lighter-than-air ship.

Employer, Employee, and the Public

THE outstanding lesson of the recent general strike in Great Britain was that a fight to the finish between capital and labor hurt the public more than it did the employer and the employee. For every workman concerned in the strike, there were ten citizens whose daily life was disorganized and whose very existence was threatened. Thanks to a more enlightened policy on the part of our labor leaders as compared with those of Great Britain, such a calamity as a general strike can never fall on this country. It had already been impressed upon our leaders that a strike is not merely a question between capital and labor, but between capital, labor and the public.

It is the recognition of the rights of the public, in industrial quarrels that involve the very necessities of life—coal, food and transportation—that has brought about the passage of the Watson-Parker Bill, of which we do not hesitate to affirm that, in the history of industrial relations, it is conspicuously the most notable single advance in the settlement of disputes between employers and employees. Briefly stated, the bill provides for each railroad or group of railroads, Boards of Adjustment, upon which are represented with equal power, both the management and the men. If the Local Adjustment Board is unable to settle disputed questions, the services of a prominent Mediation Board, not connected with railroad interests, consisting of five commissioners appointed by the President of the United States, may be invoked. This Board will seek to settle the dispute by the exercise of its good offices, or to bring about an agreement to arbitrate. The decision of such arbitration will be final, it will be filed with the United States District Court, and unless it were successfully impeached, it would become a judgment of the court.

Should the above methods prove ineffectual, and should it be evident that, as a consequence, a substantial interruption to interstate commerce was threatened, the President of the United States would have the right to create a Board of Investigation to report within thirty days on the facts involved in the dispute. During the Board's investigation, and for thirty days after the filing of its report, no change can be made, except by agreement of the parties to the controversy, in the conditions out of which the dispute arose.

To Teach Ship Operation

THE operation of ships, using the term in its broadest sense, has grown to be one of the most difficult and most highly specialized activities of our modern world. To build or to buy a fleet of ships is simply to stand at the threshold of a great problem containing endless ramifications. It takes highly qualified men to design a ship and to run it, but the task of developing trade for a particular line of shipping at any given port, also calls for men of very special qualifications and with a broad and intelligent understanding of the local conditions.

It was the failure to recognize these facts and act upon them, that made such a ghastly failure of the early years of the Shipping Board's operation of our newly built fleet. The story of that failure is written down in the fact that fifty million dollars had to be drawn from the United States Treasury, annually, to make good the deficit.

The recognition of these conditions has led the Massachusetts Institute of Technology to institute a new course which will prepare young men to enter the fields of shipping operation and management, and to engage in other maritime pursuits. The first and second years differ but little from the regular course in naval architecture and engineering. In the third and fourth years however, business studies in economics are introduced, and these include accounting, banking, corporation organizations, statistics, industrial relations, et cetera. Since the handling of ships cargoes is one of the largest expenses of operation and fixes the time spent in port, a study will be made of terminal facilities, methods of handling and stowing cargoes, railroad facilities and other factors involving a quick turn-around of the ship. Most heartily does the Scientific American can recommend this course to those young men who wish to enter the shipping business.

Is the Earth's Diameter Changing?

By Henry Norris Russell, Ph.D.

Professor of Astronomy at Princeton University Research Associate of the Mt. Wilson Observatory of the Carnegie Institution

THE April meetings of the various scientific societies brought out a few papers of decided astronomical interest. Probably the most important was the further account by Professor D. C. Miller of the continuation of his work with the interferometer As, however, our readers may hope before long to have this work described by the observer himself, little need be said here, except a word of admiration for Professor Miller's spirit of scientific impartiality.

After years of most laborious and careful work, all that he asserts with assurance is that some *real* influence of some sort produces the effects which he observes. Some of the features of these phenomena look very much like the effects of "motion through the ether"—others do not, and the real nature of the influences which are at work must be left for further investigation to determine—when, if and as it can With this conclusion the writer of these lines is in hearty agreement.

Among other matters of astronomical interest was Professor Stebbins' work on Alpha Coronae. This conspicuous star was found by him some years ago to be an eclipsing variable. Its period—known in advance through spectroscopic observations—is 17 days, 8 hours and 31 minutes. The eclipses are small—the loss of light being less than twenty per cent—and, if one is observable, the next two will happen in the daytime, and the observer has to wait 52 days for another chance—probably to have bad weather. It is not surprising, therefore, that years have elapsed before a sufficient number of observations of the eclipse could be secured to provide a light-curve of high accuracy. Now that this has been done, the system turns out to be an interesting one

The Moon's Motion Appears Erratic

The companion is much smaller than the principal star, and passes squarely across its disk. This affords an unusually good chance to find out whether this brighter star, like the sun, appears brighter in the middle of its disk than at the edge—for in such a case the loss of light will be greater when the obscuring body is in front of the bright, central region than when it is near the edge. This actually happens, so that it is clear that the star is like the sun in this respect.

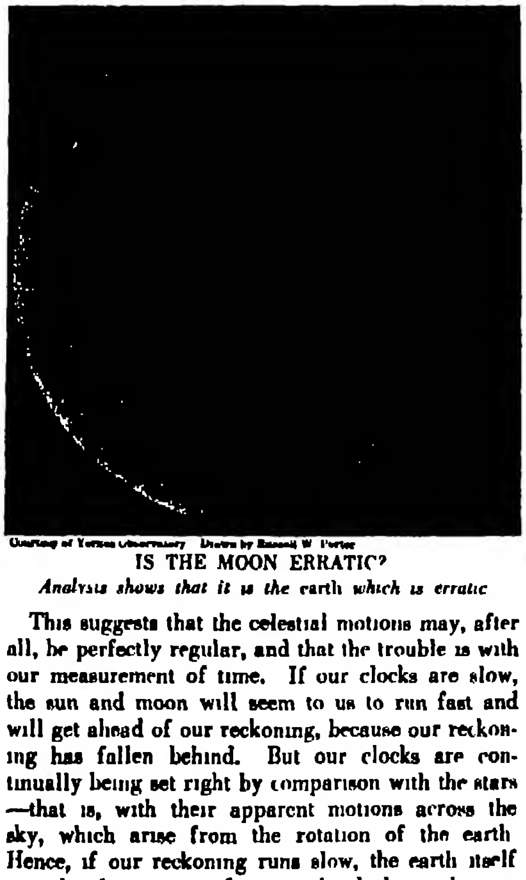
Alpha Coronae, however, is a much hotter star than the sun, and gives off about sixty times as much light. If the companion was as bright as the sun, the loss of its light, when it was eclipsed in its turn, though a minute fraction of the whole, would be detectable by Stebbins' accurate measures. No such secondary minimum appears—so that the companion must be fainter than the sun. It is smaller and less massive, but according to Stebbins' calculations, it is denser. All the facts indicate that this companion is a faint dwarf star—probably red, like most of the other dwarfs. Many such stars are known, but none has previously been detected as a close companion of a bright star—for obvious reasons.

Another communication of great interest, from Professor E. W. Brown, dealt with the strange and, so far, inexplicable irregularities in the motion of the moon.

It has long been known that the observed position of the moon did not agree perfectly with the predictions of theory: but it was not until Professor Brown completed his twenty years of theoretical work, and ten years more of numerical calculations, that it became certain that, in these excessively intricate computations, nothing had been omitted, and no errors made.

There is no doubt that, after full allowance has been made for the gravitational attraction of all known bodies, the moon's motion does not agree exactly with theory. Sometimes she is five, or even ten miles ahead in her orbit, and in other years as far behind. For years together she will be ahead, then she will start, apparently rather suddenly, to lag and, after a decade or two, may have got a little behind the place calculated for an ideal moon, moving in accordance with gravitational theory.

What does this mean? Are unknown forces acting on the moon to pull her ahead or backward? Or is there some other cause for her strange behavior? The first hint of an answer is found in the fact that it is not the moon alone which behaves in this fashion The sun, too, and Mercury, Venus and Mars, as well, all show similar irregularities, and —which is very significant—they all tend to get ahead of their calculated positions, or to fall behind them, at the same time, and the bodies which move fastest in the heavens show the greatest discordance



Courtesy of Yerkes Observatory Drawn by Russell W. Porter

IS THE MOON ERRATIC?

Analysis shows that it is the earth which is erratic

This suggests that the celestial motions may, after all, be perfectly regular, and that the trouble is with our measurement of time. If our clocks are slow, the sun and moon will seem to us to run fast and will get ahead of our reckoning, because our reckoning has fallen behind. But our clocks are continually being set right by comparison with the stars —that is, with their apparent motions across the sky, which arise from the rotation of the earth Hence, if our reckoning runs slow, the earth itself must be slowing up, if it gets ahead, the earth must be turning faster.

The total change which is demanded is not very great, amounting to the earth's running twenty or thirty seconds fast or slow, compared with an ideally perfect clock, in an interval of several decades and therefore involving a change in the length of a single day of only one or two thousandths of a second.

But even this small change is hard to explain. We cannot account for it by any frictional action, for in this case the effect would be cumulative throughout the ages To be sure, the ancient records of eclipses indicate that a slight retardation has actually happened, but this action is very slow, amounting to only a thousandth of a second per century in the length of the day, while the fluctuations which are now under discussion produce equally great or greater changes in a much shorter time. What is more, they sometimes slow up and sometimes speed up the rotation—and friction could never do the latter

Professor Brown suggests, as a more reasonable hypothesis, that the diameter of the earth may be very slightly variable If our planet should shrink, it would have to rotate faster in order to keep the momentum of rotation constant, as it must needs be, in the absence of external disturbances, if the earth should swell up, it would rotate more slowly. One percent change in diameter involves two percent change in the rate of rotation. To lengthen the day by a thousandth of a second, or about one part in 86 millions, the earth's diameter would have to increase by one part in 172 millions, or by little less than three inches. Changes a few times greater than this, with a total range of a foot or so, would account for all of the observed fluctuations.

The Earth Swells and Shrinks

In view of the geological evidence that whole mountain masses have been upheaved thousands of feet at many different epochs of the earth's history, these much smaller changes do not appear impossible We do not know what would cause them, but we do not know what forces build mountains, either If the hypothetical changes are deep-seated and affect the main core of the earth, it would probably be very hard to detect them by any other way than their effect in the rotation, for the resulting changes in sea level would be very small, and quite imperceptible if the expansion or contraction were uniform. If, on the contrary, the swelling and shrinking were confined to a superficial crust of a depth perhaps of fifty or a hundred miles, leaving the deeper mass unaffected, the necessary changes in diameter would be greater and would be measured in feet rather than inches. If changes were of different amounts in different continents, the changes in sea level would probably be sure of detection, but there is, of course, no reason to suppose that such changes, if they happened, would needs be both superficial and variable from place to place.

Why such changes should occur at all we have no idea, but it is of interest to note that, for a mass having the rather low thermal expansion of iron, a rise in temperature by only 1/1000 of a degree (Centigrade) would bring about an expansion of one part in 80 millions, which is of the order of magnitude which we are here considering Whether the material of the earth's interior, which is under enormous pressure, would expand as much for a similar rise in temperature is uncertain, but there appears to be little doubt that a general change in the internal temperature of the earth by a small fraction of a degree could produce the required change in size. The heat necessary to produce even this small rise in temperature could not get into the earth's interior from without, nor escape to the surface, except with extreme slowness, but chemical or molecular changes in the material might easily liberate or absorb such amounts of heat, or indeed much more

There seems, therefore, no reason to doubt the possibility of such changes in the size of the earth as Professor Brown suggests. The supposition that they actually happen accounts in so simple a way for the perplexing "fluctuations" in the motions of the heavenly bodies that it appears to have a great deal in its favor

PROFESSOR COCKERELL, NATURALIST, SURROUNDED BY HIS BOOKS AND SPECIMEN COLLECTIONS

Natural History for Tourists

No Matter Where You Go You Will Find a Wealth of Subjects for an Interesting Study of Living Nature

By T. D. A. Cockerell

Naturalist, and Professor of Zoology at the University of Colorado

MANY jokes are made at the expense of the American tourist. Thus, it was alleged that an American with his two daughters called on Rudyard Kipling, and on being shown into his study said, "Are you Mr. Rudyard Kipling?" The author replied, "I am." Whereupon the father said, "Girls, this is Mr. Rudyard Kipling." Then they all marched out.

They had "done" Kipling and were ready for something else.

This does not pretend to be a true story, but it is supposed to be highly characteristic. The American is understood to be collecting impressions of persons, events and objects, and his success seems to depend on the number he can obtain in the limited time at his disposal. Thus the globe trotter is subject to ridicule, as an entirely superficial person who sees everything and understands nothing, and at the end of his journey, is hardly more educated than when he started. No doubt, the criticisms are often deserved, but perhaps they are based on a partially mistaken point of view.

Perhaps we should put the emphasis not so much on the rapidity and extent of travel as on the state of mind of the traveler. People spend a lifetime in a locality, and yet overlook most of the objects of beauty and interest it affords. On the other hand, to one whose mind is richly stored with knowledge, the first ten minutes before Rome or the Nile, or the shores of England, give an impression which is something to remember during the rest of life. It is much better, of course, to take more time, but with adequate preparation even the briefest stay may be made worth while.

To those fond of natural history, the briefest opportunities may give results of scientific value. I can remember many such in my own experience. Thus, in 1893, when traveling from Vera Cruz to the City of Mexico, the train stopped at a town called Soledad. Hastening across the platform, I examined a row of trees growing on the other side, and discovered the scale insect *Chrysomphalus scutiformis*, then new to science. It is now a well known species of economic importance. In 1923, while going up the eastern coast of Siberia, I had a few moments while passengers were landed and taken on at Valentine Bay. The result was the finding of a new kind of snail, which was named *Hygromia amatoris*—in fanciful allusion to the name of the locality. In 1921, as we passed the small Cenouras Island off Porto Santo in the Madeira group, I wondered what might be found upon it. It was getting late, and I was feeling rather seasick, but in a few minutes, I had specimens of a previously unknown snail, later named *Ochthephila cenourensis*.

Adds Interest to One's Travels

To the tourist with scientific tastes, pleasure and success need not imply discovery. The old things are new to us, and no less wonderful because they have been observed before. Yet, it is a worthy ambition to wish to add something to scientific knowledge, or contribute an object of value to some great museum. It cannot be expected that the majority of tourists will become seriously interested in nature, but we venture to believe that many are capable of it, and if they do not develop their latent powers in this direction, they are losing a great deal of pleasure.

Suppose that the reader, shortly about to travel abroad, wishes to understand something of the natural history of the countries to be visited. He should take a reasonable amount of time in preparation. Securing a good map, he determines the course of his journey, and where he will probably stop. He reads certain books, readily obtainable at the public library. Having thus a background for his imagination, he looks up the histories of previous investigations and investigators, so far as circumstances permit. He soon finds that most localities or countries are classic ground to the naturalist, on account of the brilliant work of certain men. If he goes to the Hawaiian Islands, he hears of Perkins and Blackburn, if to the Madeiras, of Lowe and Wollaston. Parts of South America are still connected with the observations of Darwin; while the footprints of Wallace may be discovered, metaphorically speaking, in many islands of the Malay Archipelago.

This historical aspect should not be overlooked, for it adds human interest and quickens the desire to do something, no matter how small, worthy of remembrance. The intending traveler, now thoroughly interested, and keen to be away, has still some things to do. He goes to a large museum and looks up some of the animals belonging to the countries on his route. He may have a chance to see some of them alive in a zoological garden. Wallace, before going to the Malay Archipelago, made him-

self familiar with the birds and butterflies of that region, so far as they were represented in the British Museum. He told me that in this way he was enabled to recognize many at sight and to know when he had discovered a striking novelty.

It now becomes necessary to prepare some notes, which may be written in a little book small enough to go in the pocket. Sketches may be added to make things clearer. I always carry such a book and thus am able to recognize at once many of the things I see. During the long periods of enforced idleness on ships or trains one may take out the book and partly memorize its contents.

Possibilities of Discovery

One thing the traveler must learn is that he cannot do everything at once. It is no more possible to take note of all the animals and plants in a country than of all the people. Some form of selection is inevitable. Wallace chose to emphasize birds and butterflies, many will like to follow him in this. Others may prefer snails, or spiders, or beetles, or lizards and nearly every one will want to know something about flowers. The marine life is full of delights and we may choose to follow Dr. D. S. Jordan and think principally of fishes. Various considerations influence us. Thus, certain places are particularly rich in ferns, as Jamaica and Japan, Central America and Brazil are famous for their orchids, the Hawaiian Islands are the paradise of the conchologist.

If we are particularly keen about discovery, we go in for something a little out of the ordinary. Thus, in southern Peru last summer, I found many new wild bees, but had I collected butterflies I should have found nothing undescribed.

Then again, there is the problem of securing and preserving materials. Shells are easily packed away in small boxes, such as pill boxes. Scale insects can be put in envelopes. Beetles are easily collected in alcohol. Butterflies are harder to manage, especially when there are destructive ants which get into collections. Birds have to be shot and skinned. Mammals are even more elusive, though nocturnal species may be trapped. The practised naturalist learns how to handle whatever he is after, but the amateur may be forgiven if, since he must choose, he tends to do the easier thing. Also he often has to consider expense and bulk, and the cost of preservatives enter into his calculations. Finally he is likely to favor objects of beauty.

Perhaps shells form the most satisfactory collections, having all these considerations in mind. They

A NOTEBOOK PAGE
showing sketches and notes used in the field

also have the advantage of existing nearly all over the world in extraordinary variety. Land shells are usually of greater interest than those of the sea or fresh waters, because more localized and often with more beauty of color and form. If they are collected alive the animals may be killed in boiling water and removed with a pin. In some cases, however, it is desirable to preserve the soft parts or carry home living examples, in order that the anatomy may be studied. Thus on a small island of the Madeira group I found the curious turreted snail *Ochthephila turricula* which exists nowhere else in the world. I took some living specimens to England and they were the basis of a very important anatomical paper by Hugh Watson, of Cambridge.

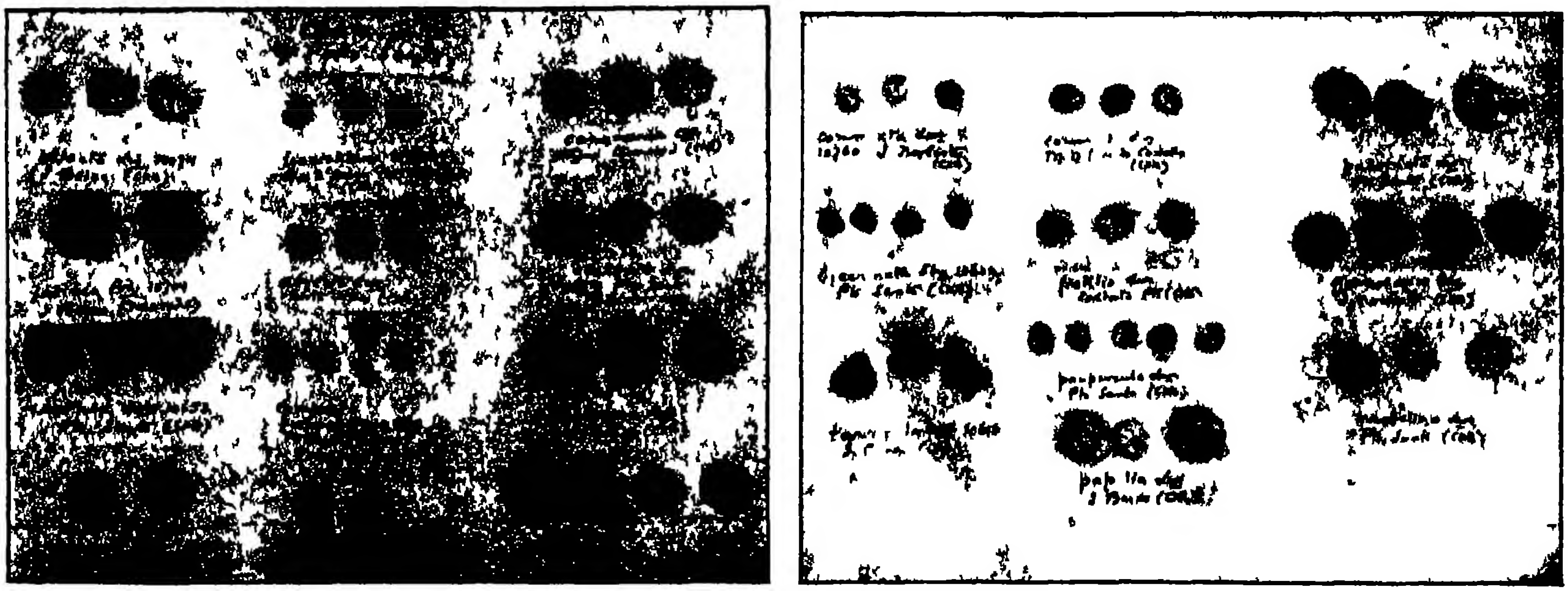
It seems to me that one is perfectly justified in observing and forming a collection on purely aesthetic grounds. Wallace, one of the greatest of naturalists, said that he was greatly influenced by love of beauty of form and color. Indeed, the love of beauty is one of the greatest sources of happiness to ourselves and others. Another motive is to preserve objects which will recall various occasions, and if they cost effort or even involved some hardship or danger, they are all the more precious. "Trophies of the chase" need not be large and cumbersome and thus out of the question for the average person.

There are, however, other and more scientific aspects which need not be disdained, nor are they so technical as to be difficult of comprehension. Thus any one may observe the life of the desert, how it is wonderfully adapted for survival under extremely arid conditions. If he is so fortunate as to visit deserts in two continents his intellectual enjoyment may be keen. Thus he has perhaps seen the many cacti in South America. In Africa, he sees what look like cacti, but closer inspection shows that they are cactus-like spurges or euphorbias. Thus, the lesson is learned that under similar conditions, similar adaptations arise in different groups.

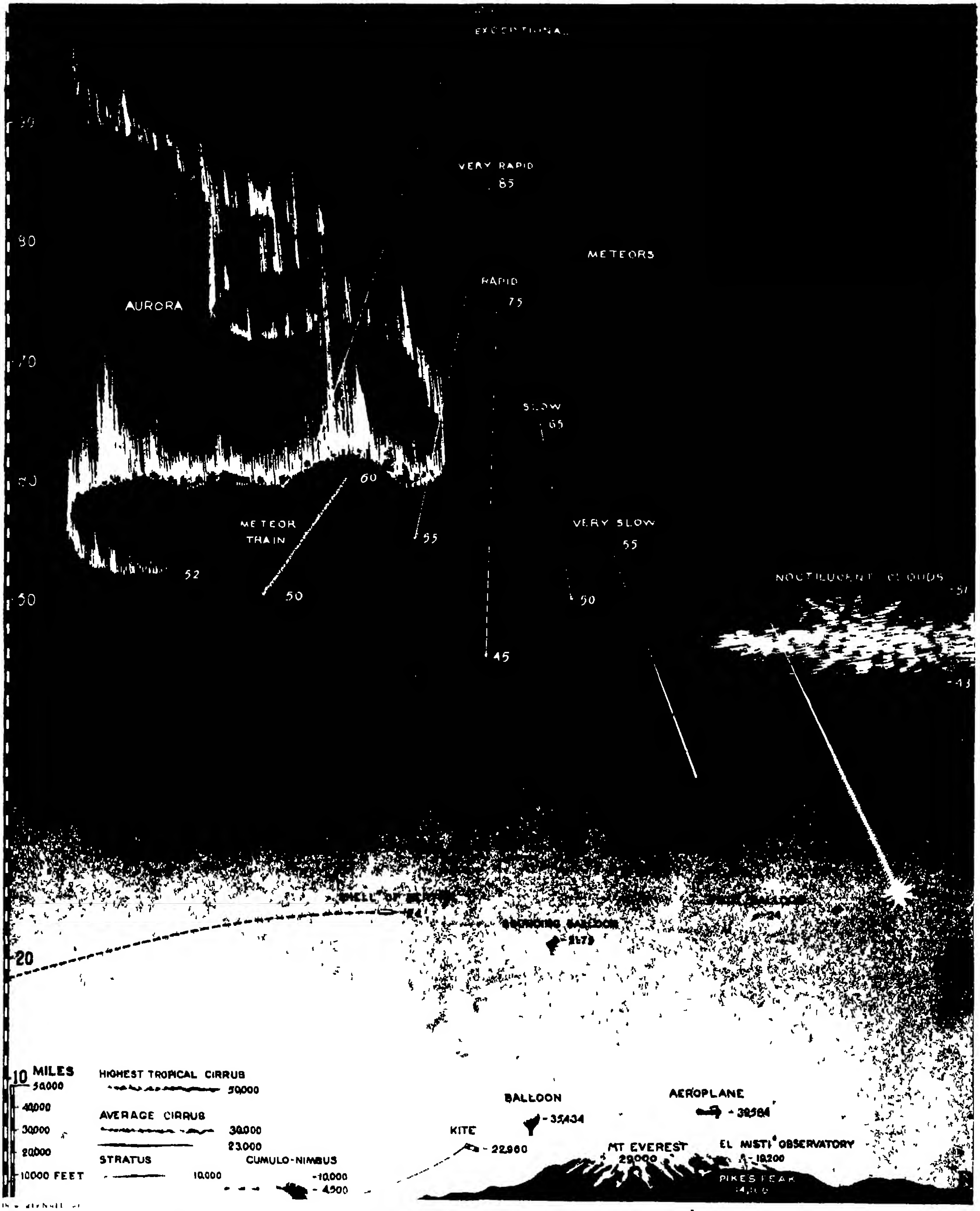
Aids Understanding of Past Events

In the moist tropical forest nature plays hide and seek and the traveler finds endless amusement in looking for that which is concealed by color or markings. In some places he may observe the phenomenon called mimicry, in which certain butterflies closely resemble others which are said to be distasteful to potential enemies, or it may be moths which look just like stinging wasps. At other times the habits of animals are full of interest, whether birds, ants or what you please. Then there is the ever present problem of geographical distribution, dependent on present conditions and past events. How interesting to find the peacock butterfly of England on the coast of eastern Siberia, or the small copper butterfly in the Madeira Islands and in Japan. So we come to understand the vastness and unity of the Palaearctic Region, stretching across Europe and Asia from the Atlantic to the Pacific.

We need natural history guide books. At first, they would have to be subsidized, but eventually they might well pay their way. Such things do exist in Europe and may often be purchased for a trifle in the bookstalls at the great railway stations. But the field has only been partially covered at best. Adequate guides covering the aspects of the subject already mentioned could not be prepared without a good deal of labor and expense, and there are not too many competent authors. Yet the thing is possible, and it should be done. The question that now rests with you is: When shall we begin?



HOW TO PRESERVE SHELLS FOR FUTURE REFERENCE
These are snails from the island of Porto Santo, mounted, labeled and placed in a glass front box to be hung on a wall



THE EARTH'S ATMOSPHERE AND ITS PRINCIPAL METEOROLOGICAL PHENOMENA IN HUNDRED-MILE CROSS-SECTION

Height above the earth is indicated by the vertical scale on the margin. Above about forty miles the atmosphere is extremely thin. The white lines represent meteor trails

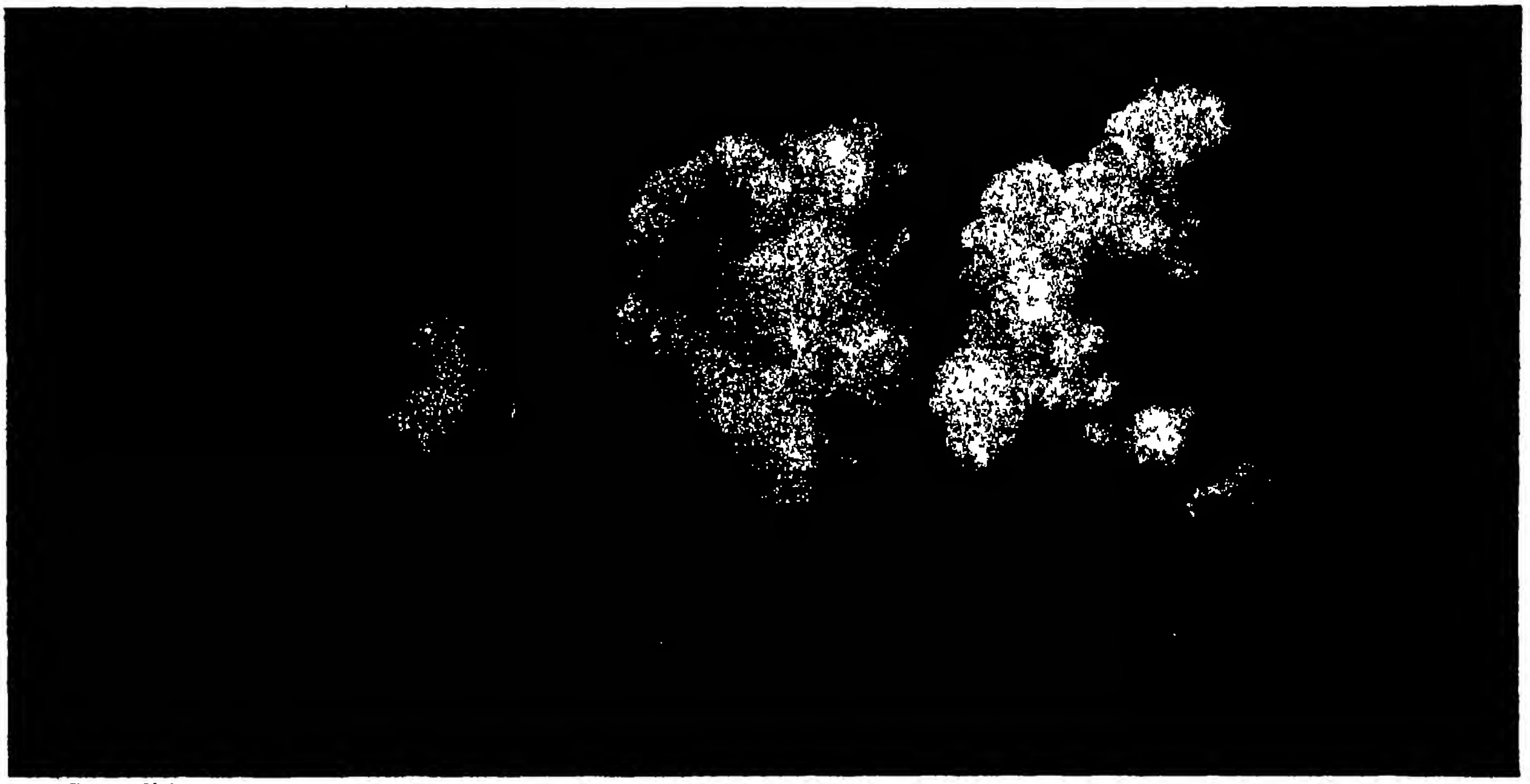


Photo from Observatory of Jorby

CUMULUS MAY REACH A HEIGHT OF 10,000 FEET. AN UPRUSH OF AIR HAS CAUSED THIS FORMATION

How High Up?

Far Above the Clouds and Extending Out Towards Empty Space There Are Many Interesting but Incompletely Understood Phenomena. Can Science Explore These Lofty Regions?

By Noel Deisch

ALTHOUGH meteorological science is ready with an abundance of good data bearing on the phenomena of the atmosphere, it is anything but forward in assigning a definite upper limit to this great ocean that surges above us. There appears to be a rather abrupt thinning out at a level of about 50 miles, but reliable evidence points to the existence of an exceedingly tenuous mantle of gas reaching far out beyond this, until finally it appears to merge imperceptibly into the void of interplanetary space.

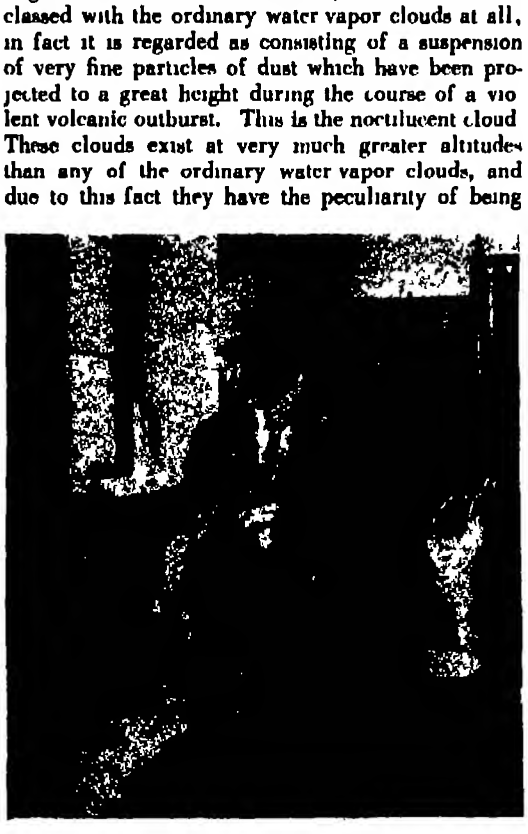
If one could climb to the summit of Mt. Everest he might look down, at the comparatively low elevation of 29,000 feet, or about five miles and a half, on practically all of the clouds. In fact the cumulus clouds, most familiar of all types, would lie well over four miles below him, for they usually float at an altitude of only about 4,500 to 6,000 feet above the earth's surface.

Atmosphere Far Beyond Zone of Twilight

The nimbus or storm clouds, which are often a development of the cumulus, may at times rise to a height of 10,000 feet, with the base still resting at a level of 4,500 feet. Stratus clouds may occur at a height of anywhere from 10,000 to 23,000 feet, whereas the most elevated of all clouds, the fleecy cirrus, are situated at an altitude of about 30,000 feet, or occasionally as high as 36,000 feet.

Clouds in the tropics occur uniformly at a greater height than in the temperate zone, and here the cirrus may at times be seen at a height of about 50,000 feet, or over nine miles.

There is another rare form of cloud which looks a good deal like a cirro-stratus, but is not to be classed with the ordinary water vapor clouds at all, in fact it is regarded as consisting of a suspension of very fine particles of dust which have been projected to a great height during the course of a violent volcanic outburst. This is the noctilucent cloud. These clouds exist at very much greater altitudes than any of the ordinary water vapor clouds, and due to this fact they have the peculiarity of being luminous in the dusk long after the sun has set, a characteristic that has given them their name.



DR. ROBERT H GODDARD
who has made valuable researches in the upper air

Such clouds, produced by the explosive eruption of Krakatoa in 1883, were found on measurement to lie at the surprising height of from 43 to 51 miles. This is the record for phenomena seen in the atmosphere by the light of the sun. The limit of the zone of twilight, beyond which the stars are visible, even in daylight, is also located just about at this level.

The meteors and the aurora, however, give spectacular evidence that the atmosphere exists far beyond the zone of twilight. Their height has been calculated with very good accuracy, the data for the trigonometrical computations being secured by a pair of observers working at stations situated at a good distance from each other—say from 10 to 50 miles or more. Meteors are generally observed visually, their tracks being plotted on a star-map, but in the case of the aurora, photographic methods are given preference over naked-eye observations.

A Streamer 375 Miles Up

It has been ascertained in this manner that the very rapid meteors usually flash a light at a height of from 75 to 85 miles and become extinct at a height of from 45 to 55 miles. The slower meteors become incandescent at a height of from 55 to 65 miles and descend to within 50 to 25 miles of the earth's surface, and on rare occasions a large one may fall right on through to solid earth.

Meteors are not often seen at heights above 80 miles, and quite rarely above 100 miles, although apparently reliable observations have on a very few occasions indicated considerably greater heights.

Very small meteors, visible only in telescopes, occur at heights computed to be from 1,000 to 4,000 miles above the earth, but these results are based on scientific inference rather than on unassailable data.

It is interesting to note that the luminous trails occasionally produced by meteors occur only in the stratum lying between about 50 and 60 miles of height, the average being about 54 miles, even though the meteor by which the train was produced may have been incandescent on either or both sides of this stratum.

Careful measurements of the height of the aurora show that the greater number of these occur at an elevation of between 53 and 200 miles, there being maxima at 62 and 66 miles

The arched form of aurora occasionally reaches up as high as 300 miles into the air In one case the Norwegian observer Stormer, who has recently obtained some very accurate results, photographed one such streamer situated at a height of 375 miles. This represents the record height for any phenomenon which can properly be conceived as occurring in the earth's atmosphere.


ROCKET FOR TESTS IN VACUO
One of Dr Goddard's experimental devices

Man Has Exceeded 28,400 Feet

The meteors and the aurora are the only witnesses which give testimony concerning the constitution of the higher regions of the atmosphere The deeper layers of the atmosphere, on the other hand, are subject to direct study, either by direct visual observation or through the intermediary of instruments. Some permanent weather observatories are located at very high elevations on mountains, such as the observatory on El Misti, Peru, at a height of about three and one-half miles Observations have also been made by special expeditions to high altitudes

The best that has ever been done by mountain climbers exceeds 28,400 feet, that being the elevation at which George H Leigh-Mallory and Andrew Irvine, of the British expedition into the Himalayas, were last seen, still climbing towards the summit of Mt. Everest, on June 8, 1924.

Balloons, which have the advantage of making but little active demand on the physical capacity of the observer, were formerly very extensively used in the investigation of the atmosphere Coxwell and Glaisher as early as 1862 reached an observed height of 29,000 feet, and rose beyond this to an estimated height of 37,000 feet, but the credit of having reached the greatest reliably observed height in a balloon is commonly accorded to the German meteorologists Berson and Süring, who on July 31, 1901, reached an altitude of 35,434 feet.

To the aeroplane, however, must be accorded the distinction of having lifted a human being to the highest point above the earth that he has as yet been able to attain, the record of 39,586 feet having been set by the French aviator Callizo in October, 1924. The difficulties of ascent at these altitudes, both as respects the machine and the pilot, are enormous. Much below this level the atmosphere is inadequate of itself for the support of life, and recourse must be had to oxygen for breathing.

Indeed, calculation shows that the present world's record lies very near the limit of attainable height even when pure oxygen is used, and it appears that if much greater heights are to be achieved measures will have to be taken to enclose the aviator in some kind of pressure-suit, or in a hermetic chamber, which will allow the pressure of the contained gas to be held at a higher value than that which prevails in the surrounding medium

So far as the mere purposes of meteorology are concerned, wholly satisfactory results can be had by sending instruments aloft unattended by an observer. For a long time kites were used to a large extent for this purpose, the record altitude being 22,960 feet, attained in a kite ascent from the Mount Weather Observatory in 1908.

Sounding balloons made of very thin sheet rubber of the best quality and so constructed as to release the instruments which they carry—themselves marvels of lightness—at the highest point of their travel, so that they may settle to the earth in a parachute, have also been much used for this purpose. Such a balloon liberated by the German meteorological service reached the surprising height of nearly 22 miles. Pilot balloons, which do not carry any apparatus but are used merely to determine the direction of air currents, have been followed with the theodolite as high as 24 miles.

Projectiles have gone yet higher, and their flight represents man's most ambitious achievement in his effort to escape the bonds that bind him to the earth. It has been computed by artillerists that the shell of the "Bertha" that bombarded Paris rose to a height of 24 miles at the apex of its trajectory, and of course it would have gone very much higher had the gun been aimed vertically.

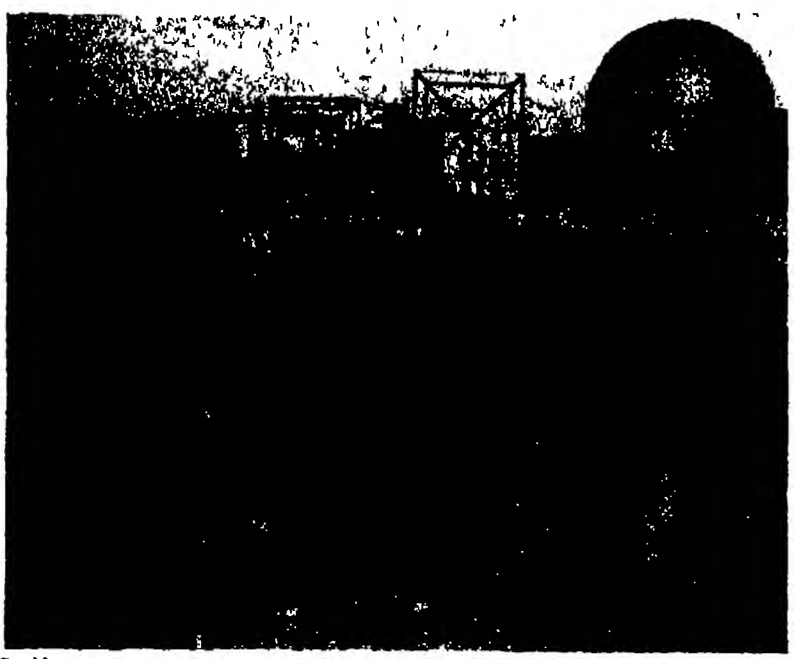
Can We Reach Higher Levels?

No attempt has been made to date, however, to utilize the ascent of shells for the purposes of meteorological research, although such suggestions have been advanced.

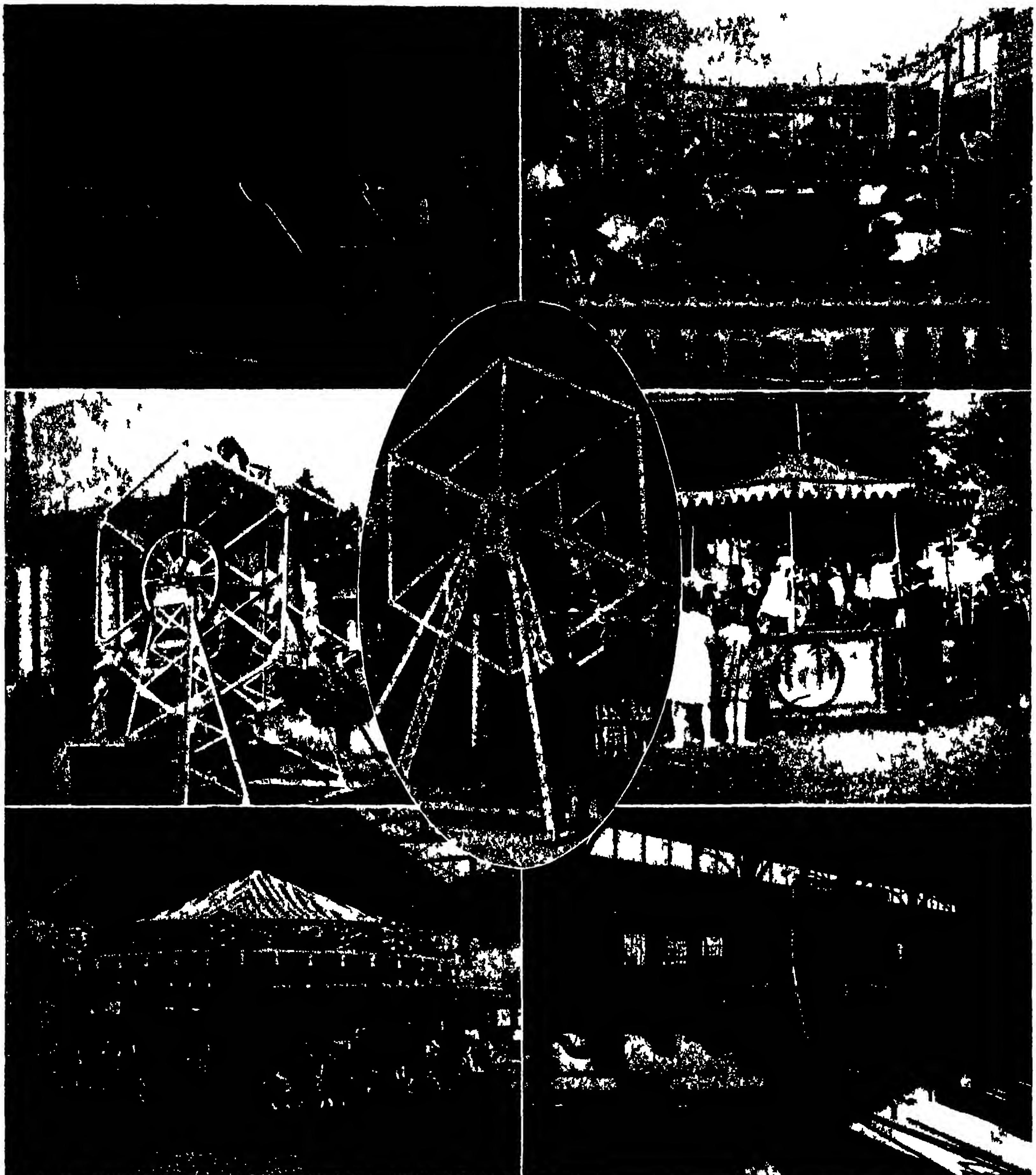
The fact that a modern high-velocity gun could throw a shell well above the zone of twilight into a region about which there is a great deal of scientific curiosity, makes these suggestions very interesting

Dr Goddard, as is quite well known, has thought to apply the rocket in this work, and has done a great amount of scientific research in an effort to put the project on a sound physical basis, the results being of a character to give great hope of this device being developed to a point where it will allow of instruments—gas-collecting apparatus, and the like—being sent to the very highest levels of the atmosphere, and indeed even into the empty region beyond.

The development of some method of this kind is of the first importance for the investigation of the vast region that lies beyond the highest ascents of sounding-balloons, a region concerning whose composition, temperature, electrical state, and so on, at various heights there is very little accurate knowledge and a vast amount of contradictory conjecture.


P. and A.
SOUNDING BALLOON
This type of balloon is used for determining air speed conditions

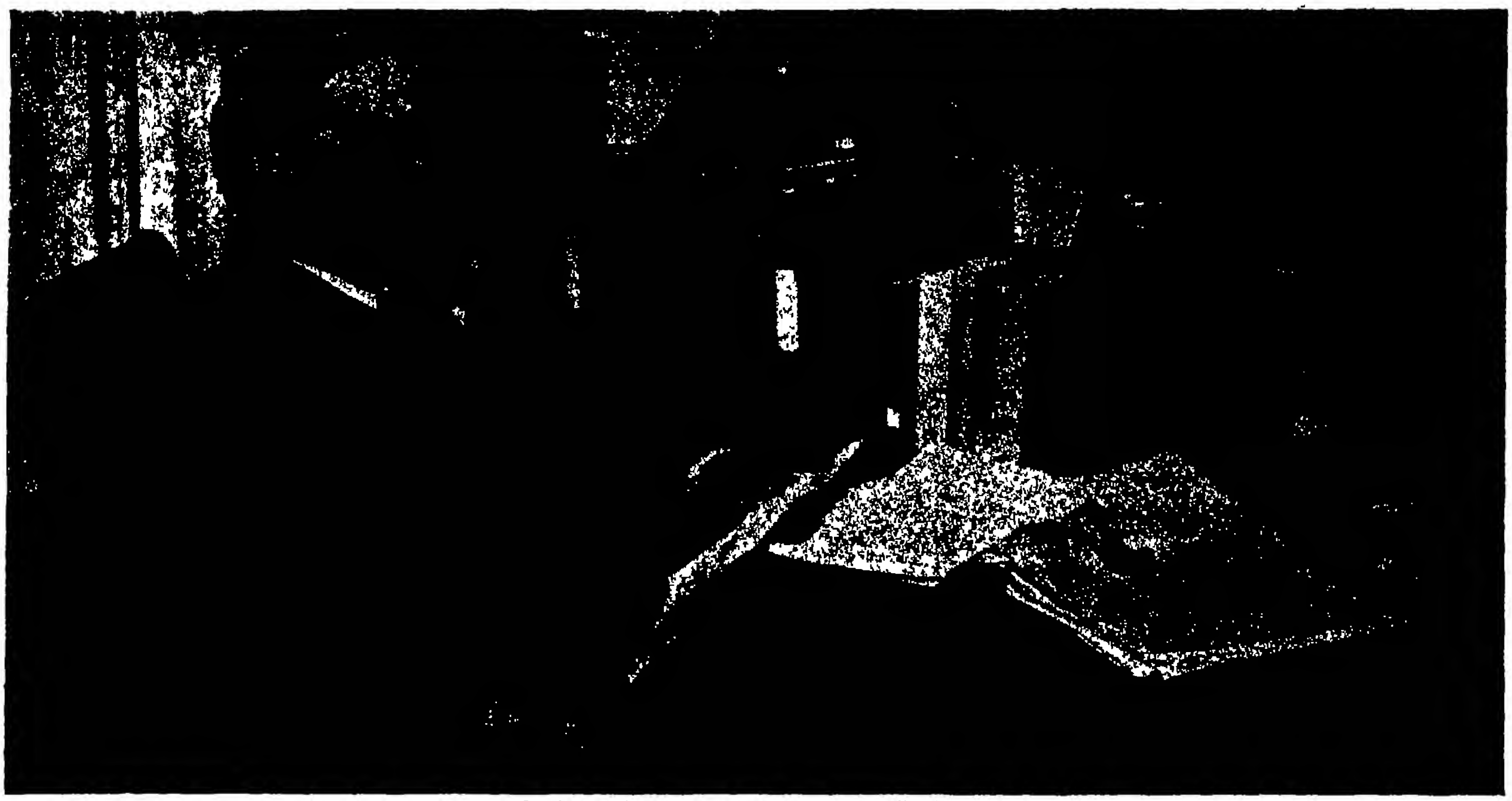

AURORA BOREALIS
This phenomenon occurs at heights ranging from 53 to 375 miles



From photographs specially made for the Scientific American under the direction of William F. Mangels

Miniature Amusement Devices for the Tiny Tots

In the larger contrivances designed for thrills and amusement the speed is so great that the children have to be tied in and there is anxiety until the little ones are restored to their parents. Many of the so-called "rides" are now made in miniature so that the child's joy need not be mixed with fear. In the upper left hand illustration we show the well known "whip" car with a small edition of the same beside it. At the upper right a whole installation of the whip laid out for children is shown. Ferris wheels do not present much danger, but wire-screened cars (as shown in the center illustration) at least look safer than an earlier model shown to the left of this. At the lower left is shown a medium size merry-go-round. In the miniature roller coaster shown at the lower right the humps and bumps are gentle. Directly above this a merry-go-round for very small patrons is shown.



DR. PRINCE, NOTED PSYCHIC INVESTIGATOR, IN HIS STUDY

Before him are four of the five printed "Patience Worth" books, also 15 volumes of typed records The loose sheets are the results of his personal studies while in St Louis

The Riddle of Patience Worth

Here Are Presented the Records, to Date, of an Investigation Conducted in a Scientific Manner by a Serious-minded Seeker After the Truth

By Walter Franklin Prince, Ph.D.
Research Officer, Boston Society for Psychic Research

IN August, 1912, Mrs Emily Hutchings and Mrs Pearl Lenore Curran of St Louis began to dabble with the ouija board, the latter, at least, in no spirit of seriousness or belief. Commonplace stuff resulted, in part banal "messages" claiming to be from dead relatives and friends. It was not deemed worth while to make any record But at two consecutive sittings material of a markedly literary character was received and at the next, July 8, 1915, came this.

> "Many moons ago I lived Again I come—Patience Worth my name [Interruption by surprised sitters.] "Wait, I would speak with thee If thou shalt live, then so shall I I make my bread by thy hearth Good friends, let us be merrie. The time for work is past. Let the tabby drowse and blink her wisdom to the fire log"

A few sentences followed this quaint and striking paragraph, and some one ventured a joke at the expense of the purported communicator, who retorted

> "Wilt thou but stay thy tung [archaic spelling characteristic of a part of Patience Worth's output]! On rock ribbed walls beat wisdom's waves. Why speak for me? My tung was loosed when thine was yet to be."

Thus emerged from somewhere the genius of "Patience Worth," full-orbed, like Aphrodite from the sea Since then a stream of poetry, fiction and table talk has been pouring forth, embodying extraordinary mastery and variety of literary expression, spirituality, wisdom, knowledge and wit. Never inferior, often the literature rises to a very high level of beauty. There is a facility in the employment of brilliant metaphor which seems to me hardly surpassed.

At first, all was spelled out on the ouija board. Then the letters began to come in the mind of Mrs. Curran (who proved to be the psychic in the case), and the pointer simply swept around the board as a vestigial automatism. Then the board was discarded and the psychic spelled so rapidly, with no pauses between the words, that only an experienced recorder could follow the delivery. At last came the stage of receiving by words, uttered at a speed limited only by the capability of the scribe, who, for the sake of accuracy, can use shorthand only in part, because of the peculiarities of the diction Mrs Curran is quite conscious at the time, and can at any moment break off to converse or answer the telephone, resuming where the dictation stopped.

"Patience" Shows Unusual Versatility

A novel of the time of Christ, "A Sorry Tale," of 325,000 words, was composed, spelled out letter by letter, before witnesses. It was published by Henry Holt and Company, and has been pronounced one of the finest attempts to portray that period. An idyll called "Telka" and laid in the Seventeenth Century, to be published soon is, in the judgment of some literary experts who have read it, a masterpiece. When I had gone about two-thirds of the way through it I felt sure that it had reached a climax from which it must fall off disappointingly; but the last fifteen pages or so proved to be of such poignant beauty that I walked the floor repeatedly before I could command myself sufficiently to go on —a rare experience.

"Telka" is said to contain the largest percentage of words of Anglo-Saxon origin in any known book since Wyclif's Bible. "Hope Trueblood," also issued by Holt, is a story in modern English laid in mid Victorian England. Some British reviewers disparaged it and some highly lauded it; but only one (who may have heard a rumor about "Patience Worth") suggested that it might not have been written by an Englishwoman. One of the hardest literary feats is to get the proper local color and stamp of local language. Yet not a British critic found flaws in respect to these—and Mrs. Curran had never been outside the Mississippi valley. Three other books of poetry and prose have been printed. There is little doubt that had it not been for the ouija board "fly in the amber," the Patience Worth literature would have won a wider recognition than it yet has done But it undoubtedly appeals more to highly intelligent and fastidious minds than to the masses that eagerly read and speedily forgot the clever jingles of Will Carleton and Ella Wheeler Wilcox.

One of the astonishing features of the case is that an auditor may select a subject for a poem and, no matter how unusual the subject is, within a few seconds the poem begins. It proceeds with all the usual rapidity, pauses being made only to allow the recorder to catch up, with never a correction. I was present at a meeting of the Artist's Guild of St. Louis where more than twenty short poems were

dictated on subjects given at the moment. The poetry is sometimes in rhyme, but usually is in rhythmic free verse of iambic meter. I can present but a few briefer bits so composed. Let it be understood that the delivery, in every case, began almost instantly after the subject was given.

Discouragement

"To acknowledge defeat?
When God hath flung the sun
From His open hand,
Lifted the curtain of the day,
And said: 'Behold, my child, behold?'"

A Field of Daffodils

"x x x the great God
In a sudden mercy, bent
And kissed the field,
And lo! the soil was pregnant
And gave forth a golden smile."

Pompeii

"Like a jewel of pearls about the hillock's throat,
The proud, proud hillock, with her head of fire,
Like a necklet of pearls about her false, false throat—
An instant, and behold!
The labor of time becometh naught
But ash and smouldering ember."

Keats's words (misquoted by proponent) "Magic casements opening upon fairy fields forlorn"

"I see fair fields where tufted poppies flaunt
And grain sags heavy 'pon its stem,
Where larks nest in the shadowed coves
At roots where damp still clings
Cool, restful cool, and quiet is the spot,
And riotous poppies fringed about the nest
Bleed in their joy.

I see the hillocks, wrapped in purple shadows
Veilèd of mist, watched by sentinels—
The pale, pale stars,
Or guarded by the jeweled moon.
I see a river winding hence,
Plunging seaward in exulting joy.

I see cool pools sunk deep within the shadowed spots,
In some far forest glades,
Molten of sunlight and of shadow,
Woven of mysteries reflected from the sky—
A vagrant cloud, a half-hid star,
Some fright-winged bird, inscribed.

I see a fair, fair land a little way beyond—
A magic land; and I would dream
Behind the casement—fancy.
Yea, I would retreat, letting my soul
Go roving, while I watch and sing"

MRS. PEARL LENORE CURRAN
at eighteen years of age, with father and dog

Thought-Compelling Psychic Phenomena

Amazing as are the annals of the psychic world, we doubt whether a more thought-compelling account of a psychic event than that which appears on these pages has ever been published. A woman of plain, simple antecedents suddenly develops the ability to phrase prose or poetry of recognized worth, either in the language of old England or in that of other periods, and to do so on such instant call, and with a display of linguistic and topical knowledge far exceeding that which scholars familiar with the case can so far explain on the basis of her experience. True, similar demonstrations under certain conditions have been "faked," and it will be noted that the well-known author of this account makes no final claims for its genuineness. He simply states the case, adds a few observations concerning it, and leaves the problem open.

Those who have read Dr. Prince's previous articles in the Scientific American, and those who know of his life-long investigations in the field of psychical research, will doubtless agree with us that he is actuated by truly scientific motives, not deliberately setting out to establish the genuineness of a given psychic phenomenon, but, if possible, to ascertain the truth.—EDITOR

To the subject "*Flappers*," she instantly and laconically responded, "They dare what the past hoped for", and in response to "*The Press*," she contented herself by cynically ejaculating, "The gab wench of the day."

Here are a few of the aphorisms of "Patience Worth," flung off like sparks in conversation. "Beat the hound and lose the hare," "A basting but toughens an old goose," "To catch a flea needs be a dog?" "Prod ye the donkey's rump, ye are sure of a kick," "The jackass deemeth the thrush hath stolen of his song," "The piggie that scratcheth upon an oak doth deem his fleas the falling acorns' cause," "Thy abode is *within*."

There is a quickness and aptness of witty retort such as I have never known equalled. When some one wished that she might know of the after life, "Patience" flashed out, "Ask the cat—she dieth full oft", and a discontented woman who expressed vain wishes was told, "From constant wishing the moon may tip for thee." To one who objected that a certain expression is known in connection with a personage of the Nineteenth Century whereas Patience claims to have lived in the Seventeenth, she retorted, "Dost thou flatter thyself that today's thoughts and deeds were born today, by such a fledgling as thou?"

Often persons get responses to subjects suggested by them which seem to show uncanny knowledge of their unexpressed thoughts. One of my several experiences of this kind is as follows: In my house is a cocker spaniel whose love and devotion are so extraordinary, even for a dog, that I have sometimes remarked, "It is awe inspiring! It is cosmic! It seems as though I were realizing a force in the universe expressing itself in that dog." But nothing of the kind did I say in St. Louis when I gave the subject, "A Cocker Spaniel" This is what Patience said

"Is it God within those deep, deep eyes?
Could love express from human kind
More than the tremble of thy flesh,
The eagerness of thy desire,
The leap of thy service?
Once I have known thee have I not known God—
Have I not found Him in a newer way expressed?
Companion, making one with my day,
A fellow, mute yet eloquent!
Can I forget thou art the game at my hand
And the servant at my feet?"

Besides being a terse description of the dog, this beautiful verse expresses the thought in my mind when I named the subject.

What Is the Answer?

The Patience Worth literature, as produced through the mouth of Mrs. Curran, presents several weighty problems.

I The problem of literary genius By all the testimony yet gathered, that of Mrs Curran and of others who knew her at different periods, she had never shown, before the advent of "Patience Worth," literary talent, never practiced to attain it and never aspired in that direction Like a large percentage of girls, at the romantic age she perpetrated two or three sets of rhymes I saw one of them in the original manuscript It was mere doggerel More than that, she had read little, not at all discriminatingly, and had no particular taste for poetry

II. The problem of knowledge It is declared that her school education ended at fourteen, short of the high school, except for music, which she cultivated and in which her ambition centered. It seems to be established that she has very little normal knowledge of history or foreign lands and that she never made a study of words. Yet Patience seems

MRS. CURRAN TODAY
Showing her at the time of the writing of this article

to have not inerrant but a great deal of knowledge regarding the past and other countries. She also uses correctly many archaic words and forms others from Anglo Saxon roots.

III The problem of wisdom. Mrs Curran is a bright and alert woman but never according to testimony did she manifest in her speech anything to approach the profound sagacity and the lofty spirituality which pours automatically from her lips.

IV The problem of seeming divination of what is in human minds. Certainly Mrs Curran had not appeared to have that mysterious faculty.

So impossible did it appear normally to account for this product on the basis of Mrs Curran herself that at one stage there was a theory that some literary genius and scholar composed what she memorized and recited. But instant composition on suggested subjects killed that theory.

Then it was suggested that she got the literature by telepathy from the intellectual group gathered around her. But it gathered around her because Patience had already dictated. The group varied and at times was not intellectual, but Patience continued unaltered.

One psychologist whose theories are confirmed and inflexible, wanted to hypnotize her feeling sure that thus the story of her life would furnish an explanation. But he would poke her with his finger asking "Do you feel that?" and since she is without hysterical stigmata it produced an unpleasant impression and she declined to be hypnotized. I should not have advised otherwise in this case for while facts can be drawn out by hypnotism a violently prejudiced person can also interject them. The elicited story might have been as much the result of his suggestions as is the belief of a hypnotized subject that an onion is an apple.

Another psychologist has written a long article about her. He exonerates her from having any conscious education in or out of school to fit her for the literature. He exonerates her reading entirely. He credits that she had never associated habitually with historians or philologists and believes her when she says that she had no memory of ever hearing any such scholars talk. But he thinks that below the threshold of her consciousness is a secondary personality which has subconsciously listened to information of which she was consciously entirely unaware. But this would require that she did not hear only a few times subconsciously for instance philologists using archaic words and *defining* them but there must have been a vast deal of this going on and yet she has no remembrance of ever being in the company of persons holding such discourse a single time. Not only this but we may search the records of split consciousness in vain to find a secondary personality which suddenly manifested talent amounting to genius in a field wherein the normal consciousness had never shown any noticeable talent had any practice nor cherished any such ambitions.

The Folly of Atheism

[She] Hae ye seen the mummers settin up a puppet show, athin the fielding?
[He] Nae
Who doubts his God is but a lout;
Who piths his wisdom with egotry
Hath lost his mark
[She] Aye. I see'd 'em fetchin past, and brayed o'er wi' a ribbon and a new latchet, and a shoon bucklin and tasseled thongs
To doubt is but to cast thee as a stone
Unto the very heart of God.
[He] Aye, and I fetched me a whistle; and heered the doings of the village — that Mark, o' the smithy, haed a new wench; and she be heft
[She] Aye, a wide tale. I heered it, but heeded it nae, I bein' feastin 'pon the new thong
Who doubts his God
Hath but announced his own weak limitation,
Hath tied his hand and fettered of his foot.
[He] Weel, 'gad! Did ye see the dominie wi' his new breeks, and a sabba' shirt?
Weel, can ye heed it, and him at the Fair?
A wide tale, eh?
To doubt thy God
Is but to stop the everlasting flow of mercy;
To die of thirst and lose thee in the chaos of thyself

Here is the puzzle of Patience Worth, and I present the case at this time only as such. I want to rake Mrs Curran's past with a fine-tooth comb, and she is willing that it shall be done. If any person living is in the possession of knowledge about her which will or may present any clue, I shall be grateful to receive it and I request all readers who knew her before 1913 to write to me and tell what they know.

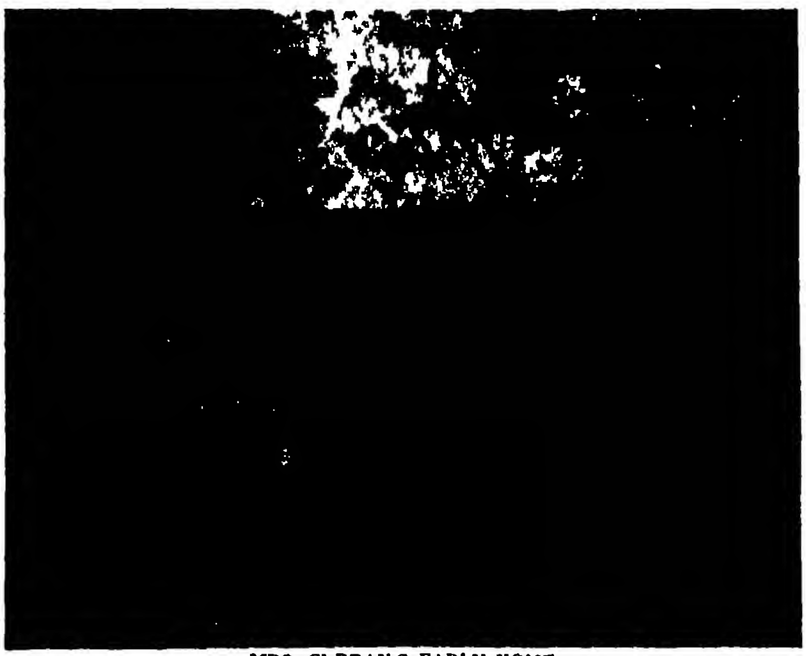
Psychologically or psychically, the case is the most amazing one of its kind in history. It was possible to give here only a glimpse of its magnitude. The few brief passages have been taken almost at random. I have as yet only nibbled at the fifteen volumes of records now in my possession, in addition to the printed works, altogether containing three million words.

Were there space it would be interesting to learn the results of some of the unusual tests which I devised. A poem of twenty five lines was demanded, the lines beginning with the letters of the alphabet, except X, in due order. It was instantly dictated. I asked for a conversation between a lout and a maid at a country fair, to be couched in archaic prose and a poem in modern English on "The Folly of Atheism"—first a passage of one and then a passage of the other thus alternating to the end. This seemed to me an impossible mental feat. But it was done so rapidly as to tax the recorder—four passages of humorous prose abounding in archaic locutions alternating with four parts of a poem in modern English of lofty and spiritual tenor, and when assembled each factor made a perfectly articulated little piece of literature.

"Patience Worth" treats doubts regarding her being with humorous forbearance. To her name given as a subject she responded

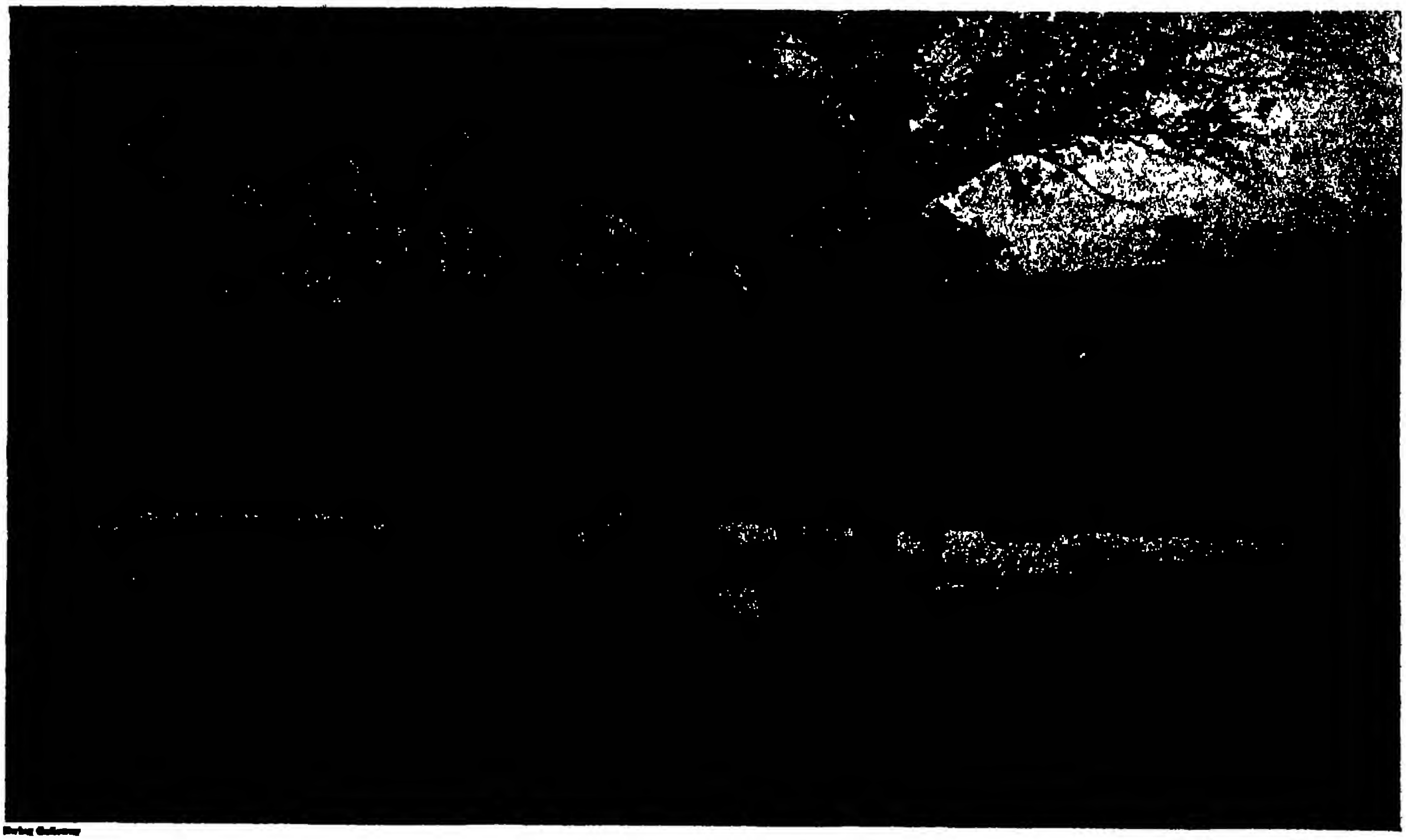
"A phantom? Weel enough,
Prove *thyself* to *me*
I say behold here *I* be
Buskins kirtle cap and petticoats,
And much tongue!
Weel what has thou to prove *thee?*"

What wonders there are to be found in the depths of the sea! What beautiful masses of coral and schools of fish! These were studied by means of the Williamson under-sea tube. A description of this work by Roy Waldo Miner will be found in our August issue



MRS CURRAN'S EARLY HOME
located in the quiet secluded town of Palmer Missouri

MRS CURRAN'S PRESENT HOME
in St Louis, Missouri is shown at the right of the illustration



Science Invades the Farm

It Is a Far Cry from the Man Behind the Plow to the Modern "Once-over" Tiller Drawn by a Gasoline or Steam Propelled Tractor

By Archer P. Whallon

ONCE there was a lazy country boy (he now is a writer for scientific magazines) who had a big imagination. He pictured the day when a farmer would press a few electric buttons and all the work of caring for the old 180-acre farm—the plowing, the harrowing, the seeding, the cultivating, the reaping, the binding, and all the rest of it—would be done automatically.

A wild idea, they told him when he spoke of it at the supper table. But thirty years have rolled by since then, and it begins to look as though the boy's picture of the future might become a reality after all. At any rate, a long step forward has been taken. Today the up-to-date farmer has at his command a wealth of labor-saving devices.

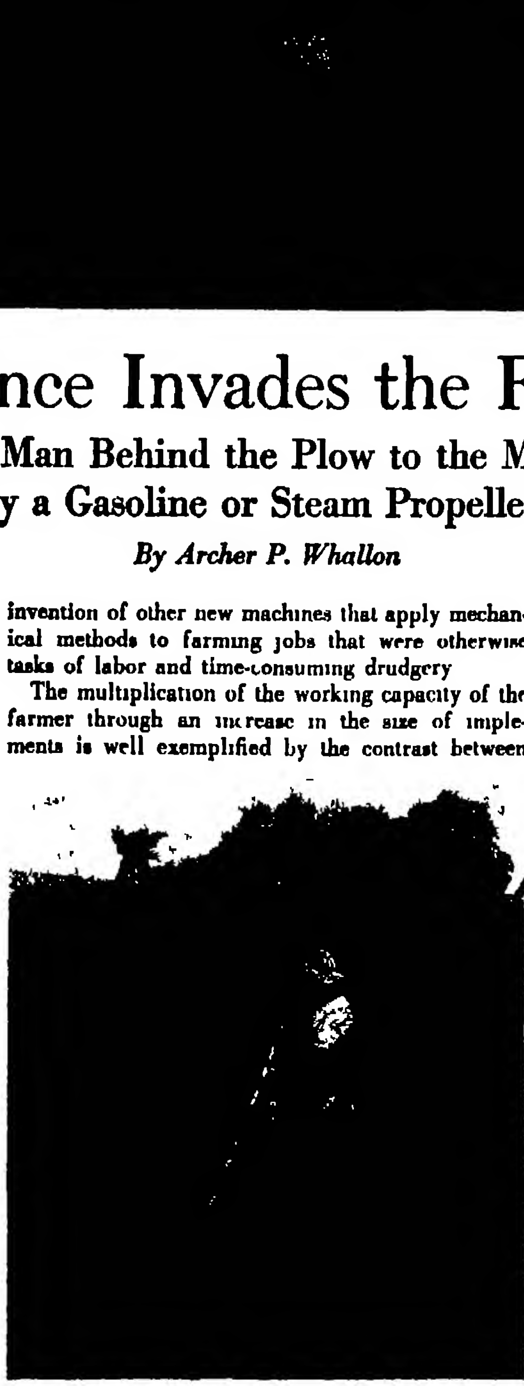
More Play Less Work

A new day has dawned on the farm—a day in which the farmer need not grow old before his time, a day in which he can work less and play more than did his father and yet make the old place pay as his father never was able to do.

And this new day has been ushered in by a flood of time-saving and labor-saving inventions.

The current of farm machine invention flows in three parallel streams of activity; the development of larger sized and more efficient implements and equipment used in the prevailing farming practice; the invention of new types of machines that eliminate some of the tasks that have hitherto been necessary in the sequence of crop production; and the invention of other new machines that apply mechanical methods to farming jobs that were otherwise tasks of labor and time-consuming drudgery.

The multiplication of the working capacity of the farmer through an increase in the size of implements is well exemplified by the contrast between the man working with a two-horse, six-foot smoothing harrow, plodding along in the dirt, and the tractor which pulls over one hundred feet of the same implement—a contrast about as striking as that between the first-named outfit and the drudging Oriental equipped with a hand rake.



THE OLD WAY
Tedious hand work is giving way to farm machinery. Result: Greater profit from the land

But American farming efficiency is advanced not only by increasing the size of implements, but also through the development of more economical power plants. A notable example of this development is shown in the appearance of two steam farm tractors which unite features (steam condensers and automatic fuel regulation) that give them the convenience and versatility of the gas-engine tractor, while retaining the well recognized merits of reliability, economy, and durability of the old-time steam traction engine. Both are twenty-horsepower engines, the one an oil-fuel machine, the other having a coal-burning boiler.

Perfect Seed Bed in One Operation

Innovations that revolutionize farming methods by combining in one operation—a single passage over the field—work that must otherwise require several successive operations, are obviously of the greatest economic value. Here, in the initial tasks of plowing and soil fitting a relatively new implement enters—the universal or "once-over" tiller. It combines the advantages of the common moldboard plow and those of the complicated power-driven rotary tillers of Europe. This machine, furnished for attachment to the ubiquitous small tractor, consists of a plow

bottom fitted with a power driven bladed or toothed rotating member that catches the furrow slice as it turns from the plow and thoroughly pulverizing it forms a perfect seed bed at the single passage over the field

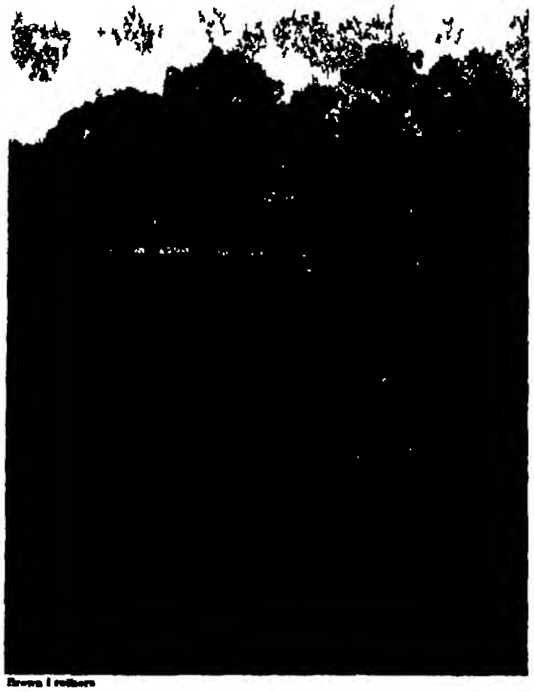
Originally in its practical realization the product of the Pacific coast the combined harvester thresher has now found its place and is revolutionizing grain production throughout the world There are now around 1000 small type combined harvesters in Kansas and an invasion of the harvest fields of Illinois and Indiana has taken place

Mechanical Maturing Possible

These small combines have their mechanism driven by an attached motor and with headers from 9 to 18 feet wide, may be drawn by light tractors (the 9 foot by the Fordson) or by from 8 to 20 horses The grain may be sacked or in the bulk grain method, delivered to an accompanying wagon or carried in a tank mounted on the harvester and later disposed of as desired

Ordinarily the straw leaves the harvester in a windrow but straw spreading attachments are furnished. Other attachments for leaving the straw in piles convenient for haulage are also furnished Further, there is equipment for the stationary threshing of bundled grain (self feeders and straw stackers) and for harvesting and threshing kaffir corn and the other grain sorghums

Bean and pea harvesting equipment is also made and some makes can be fitted for harvesting sweet clover and soy beans Several companies make hill side models that can be operated on 50 percent



Brown Brothers

FOLLOWING THE HORSES

This slow harrowing process is now combined with plowing by machinery

grades With most designs the header is detachable and may be mounted on a transport truck and trailed at the rear of the thresher This is for convenience in passing along roads as well as for allowing the machine to be taken through narrow gates and over bridges

The advantage of the combine in labor saving over all other harvesting methods is obvious and incontestable One trip over the field and the job is done! There is no delay during which the crop may be damaged On the contrary the grain is in the sack and the field cleared ready to be fitted for another crop—and the farmer has no binder twine or threshing bill to meet Two or three men do the work of the dozen that are required by the binder or header and by stationary thresher methods It is even possible under favorable conditions for one man to do the whole job

In monetary terms this works out—for wheat harvesting—to be a reduction in cost from $0 226 per bushel required by the binder and stationary thresher method to only $0 034 for the combine"

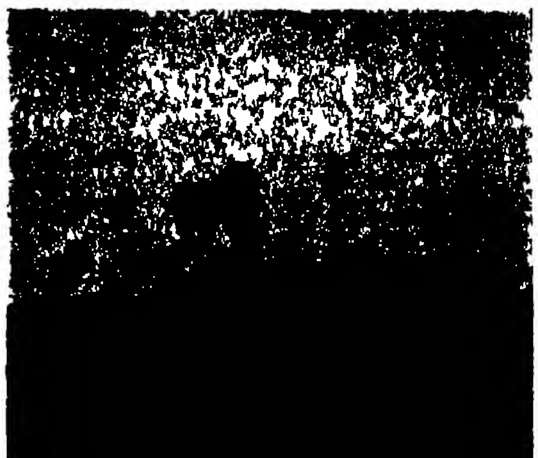
In Kansas, Nebraska, Colorado, Oklahoma, and Texas there are about 161,000 square miles of land, with an approximate production of 150,000,000 bushels, that may be conservatively regarded as "combining" territory This does not make any claim for extensions due to possible further adaptive modifications of the machines

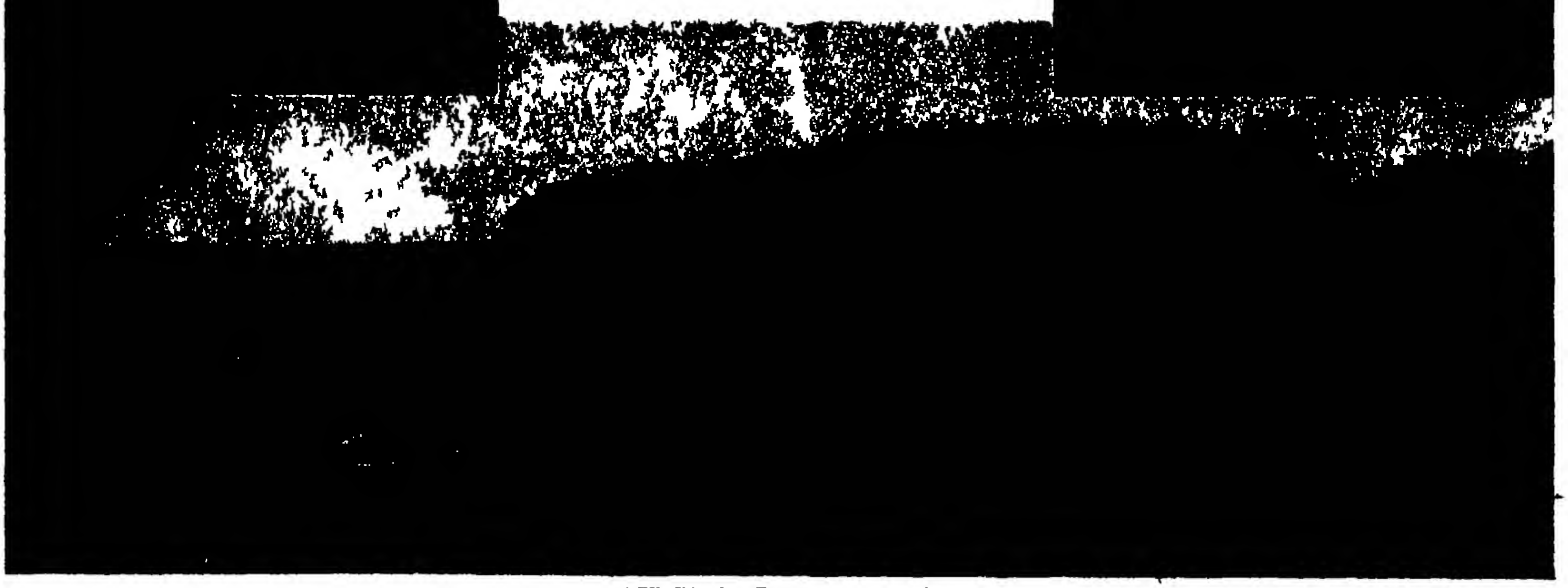
It has long been the prevailing opinion that grain must attain a condition of uniform maturity in order that it may be successfully handled by simultaneous cutting and threshing, a condition only met by a tranquil and somewhat arid climate More recent experience seems to show that the necessity of this condition has been overestimated, and there appears the further possibility of extending the field of service of the combined harvester through artificial or mechanical curing or drying of the threshed grain

Machines Designed for All Harvesting

These labor saving machines in the grain field have their counterparts in the harvesting of other crops We have now the combined bean harvester and the combined clover seed huller The corn picker and the ensilage harvester are working a revolution in corn growing

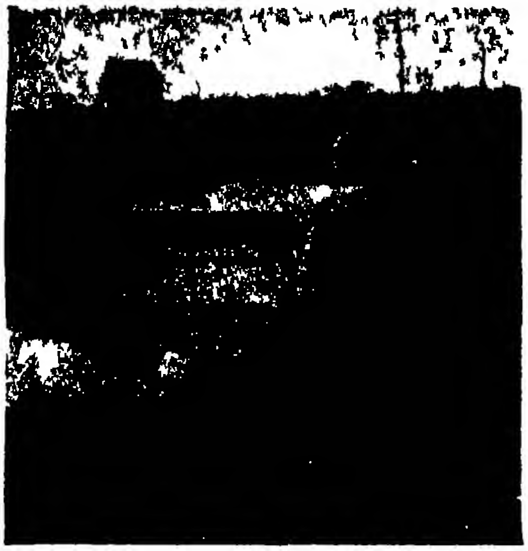
Throughout the corn belt and in all territories where it is not considered desirable to harvest the stalks the field picker is destined to become the standard corn harvester Indeed so efficient are these machines that for one type the ability to pick pop corn and green sweet corn for canning, is claimed The picker picks and husks the corn ears and delivers them to an accompanying wagon the stalks remaining in the field Not more than two





SPEEDING UP FARM PRODUCTION

Upper left photograph illustrates a combined harvester and thresher Center photograph shows a 10 ton caterpillar tractor drawing a 108 foot long harrow In the upper right illustration a harvesting machine for sweet clover is shown



WAR ON BUGS

This sprayer can treat acres of crops each day

operators are required for the outfits the tractor drawn machines having a capacity of from 8 to 10 acres a day, as compared with about an acre and a half for a good hand picker

The ensilage harvester cuts the standing corn plant, stalks and ears, converts it into ensilage and delivers it to the accompanying wagon, thus saving the labor of five men on the ordinary silo filling job "Bringing in the sheaves" and when the corn is in the shock," although time honored and picturesque phrases, imply conditions of altogether too much inefficiency and drudgery to be endured

Root and textile crops are also yielding to mechanical harvesting In addition to the familiar elevator potato digger, we now have sugar beet harvesters There are a dozen or more French and German machines of this type Although there seems to be but one American design commercially manufactured it offers greater practical advantages This machine cuts the tops from the beets lifts the roots from the ground, and puts them in piles so that they can be readily picked up There is also an attachment for saving the tops

Flax and hemp harvesting machines are passing out of the experimental stage, and there has now been developed a cotton harvester which makes use of the basic idea of suction--the same principle as that employed in the vacuum sweeper familiar to the housewife This machine is mounted on a Ford son tractor and can be driven through the rows without damage to the cotton plants The speed of the operators using the machine is about five times that of hand pickers While the machine has not as yet found extensive enough employment to exert an economic influence, of all the many inventions designed for cotton picking it is by far the most practical and may some day be considered as epoch making as Whitney's cotton gin

Although the garden tractor is a small machine, its importance should not be minimized for these small power plants that supersede horse or man power in garden tillage bid fair to revolutionize the intensive farming of the world Their advantage lies not only in the fact that they multiply the output of the laborer from three to five times but in that unlike the horse, they do not need feed or attention when idle and they will serve to bring into production small farms and city and suburban lots which are now idle, where cultivation with the horse would be impossible This feature gives to these small automotives an opportunity of the first magnitude in transforming the life of crowded agricultural countries What they may ultimately do for Japan China Java India and other oriental agricultural nations may mean more for the peace and prosperity of the world than the work of the great machines of the grain fields

Farm Owners May Decrease

Unforeseen events may deflect annul or delay that which seems to be a steadfast tendency but it seems by no means presumptuous to say that viewing these changes in farming methods not as past isolated events but in prospect—as an accumulation of possibilities—the increased efficiency of the agricultural laborer will bring a further relative decrease in rural population and a release of still more workers to carry on manufacturing and commerce

Comparisons between the prevailing methods of farming and those of our colonial forefathers or of the drudging peasants of backward lands are a bit too familiar to deserve repetition nor are they exactly apposite for they are out of date and consider only to the slightest extent the employment of mechanical farm power The newer methods are of too recent introduction to more than give a hint of their influence on the shift of labor demand but even now through large sections of the grain belt the combined harvester has made the hobo harvest hand a familiar figure five years ago—a rare species

The increase in working capital required will tend to enlarge farming units transforming the small farm into a vegetable and fruit producer that will not attempt competition with the extensive plantation using large and efficient machinery An increased measure of geographical specialization in grain and staple crop growing will follow and excessive crop diversification will show itself an economic fallacy On the other hand the sugar beet harvester the cotton picker the [illegible] combine and a score of other specialized farm machines will tend to extend the territory of other crops

There is another feature involved in this evolution of the man with the hoe into the man with the monkey wrench It is the increasing part played by the plant breeder Heretofore our efforts have been largely along the lines of designing machinery to fit the crops they plant cultivate and harvest Now we are beginning to produce new varieties of plants to fit the machinery—new varieties of crops which lend themselves more readily to mechanical operations

All this you might say takes the guess work out of farming and make it more profitable Yes but it does not necessarily follow that every man on a farm will grow independently rich A tin Lizzie costs more than old Dobbin The more machinery you have the greater is the initial capital you have to invest This fact may well mean fewer farm owners and more tenants

SMALL TRACTORS FOR SMALL FIELDS

Th[illegible] are exceptionally efficient

CORN PICKER

Ears of corn are gathered without cutting the stalks

BEET HARVESTER

The beets are pulled tops cut off a[illegible] the roots piled up

Do You Know How to Get Along with People?

Why Some People Get Ahead in the World While Others do Not

By Dr. F. A. Moss
George Washington University

THIS is the age of diplomacy The polished sword has been supplanted by the polished word. The terrifying growls of anger have yielded place to the soothing words of tact In the pioneer days, when might was right and every man was a law unto himself, diplomacy meant little But times have changed

A careful study of the qualities of the so-called successful man will reveal in nine cases out of ten that his success depends not on the deep and profound something which puzzles the brains of the average man, but on the simple and more superficial something which pleases the understanding of the common folk, and arouses in their hearts a feeling of sympathy It is that congenial something which, for lack of a better name, I have defined as "social intelligence," or ability to get along with people, while the profound something, I define as "abstract intelligence," or the ability to deal with ideas

Abstract intelligence is a sort of sixth sense which explores the uncanny depths of science, social intelligence has none of the mysterious qualities of a sixth sense, but it is the life of all the five It is the ready eye, the quick ear, the judging taste, the keen smell, and the lively touch It negotiates all difficulties, and avoids all conflicts

For all practical purposes of life, social intelligence wins over abstract intelligence, ten to one Abstract intelligence knows what to do, but social intelligence knows how to get it done Those with high abstract intelligence win the laurels of scholarship, and are crowned with membership in *Phi Beta Kappa*, but later those who crowned them are disappointed that they get along no faster Those with high social intelligence rarely attain the best grades, but they are usually rewarded with all the offices that it is in the power of their fellow students to bestow, and later in life their former instructors are astounded that they get along so fast

In no trait do people differ more than in their ability to get along with others And, as pointed out above, social intelligence is one of the most important elements making for success

Realizing this, the authorities at George Washington University are attempting at the beginning of the freshman year to measure the social intelligence of each student in order to be able to assist him more intelligently in selecting courses and in planning a career in keeping with his natural aptitudes.

To discover the social ability of the various students a novel series of social intelligence tests was developed by the Psychology Department. These tests were given to all the students who entered the university this year, and are being tried out in a number of other institutions.

Several industrial concerns are also beginning to use these tests in selecting employees for positions where ability to get along with others is important.

Can You Place People?

In order that you may see what the test is like we will let you try parts of it One of the most important factors in social intelligence is the ability to recognize faces and remember names. The person who gets along best with others does not have to be introduced to a man three or four times before he remembers that he has met him before Knowing that it tickles the vanity of the average person to feel that he is remembered, the skilled salesman, if he calls at a place of business a second time, makes it a point to address the prospective customer by name The pleasurable effect of being recognized and called by name has been known by the politician from the time of the ancient Egyptians.

Two things are measured in this test One is the ability to recognize a face which has been seen before, and the other is the association of the correct name with the face As a rule the man who is best at recognizing faces is also best at remembering names, but it occasionally happens that an individual may remember having seen ten different people and not be able to recall the name of a single one Statistics on our first 1,000 cases show that people recognize faces much more often than they remember the names

If you wish to test yourself on ability to remember names and faces you can take out your watch and study the twelve faces on this page carefully for four minutes in order that you may be able to recognize them when you see them in a larger group Do not turn away immediately but read what is said about test one so that the usual time will elapse between first seeing this group of faces and having to recognize them in a larger group. You should study these twelves faces very carefully, for only about one in 400 makes a perfect score. Of the first 500 students tested at George Washington University only one remembered all the names and faces, and he is the son of a very popular United States Senator. Other things being equal, it seems that he might follow in the footsteps of his father.

A second factor of considerable importance in dealing with people is the ability to size up properly a social situation and to exercise correct judgment in meeting difficult social problems. In order to test this, 30 situations are given which require keen judgment, and a deep appreciation of human motives, to answer correctly. Four solutions are suggested to each situation, only one of which is correct. The person taking the test is instructed to place a check in front of the answer which in his opinion most satisfactorily meets the situation Three samples follow:

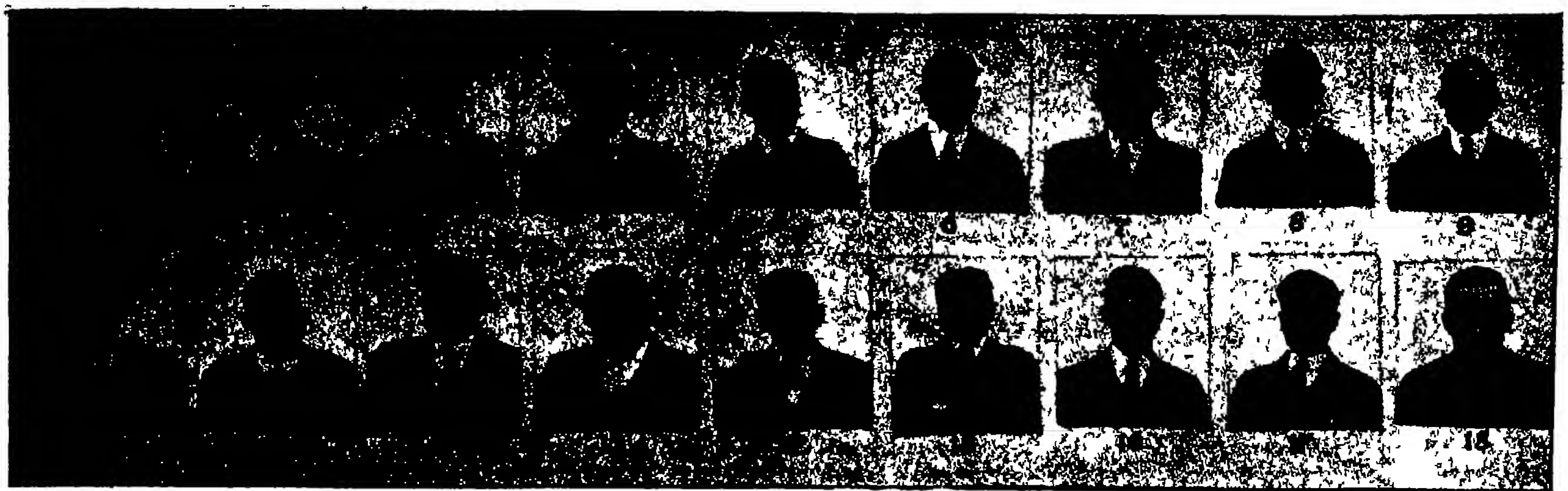
1 Henry Burton has held a subordinate position with a business firm for ten years. During this time the work assigned him has been quietly and reliably done He is a man whom his employers will miss when he is gone. On obtaining an appointment with a new firm he will be likely to
—Assume advisory responsibilities easily.
—Impress his new employer immediately with his value to the firm
—Be slow at creating opportunities for himself.
—Resign on receiving a slight criticism of his work

2. While burying their uncle, Tom proposed to four of his cousins that each deposit $20 in their uncle's casket. When the other four had each dropped in $20 in currency, Tom took the $80 and put in his check for $100 The thing which prompted Tom's conduct was most likely:
—Craftiness
—Ancestor worship
—Devotion
—Superstition

3 The bodies of an unscrupulous politician and a woman other than his wife were found in a lonely wood The man had been shot twice,

ONLY ONE IN FOUR HUNDRED SUCCEED IN THIS TEST

Study these faces for four minutes, then see if you can recognize them in the larger group on the opposite page



LOCATE THE TWELVE MEN ON THE PRECEDING PAGE
( ) *Mike Bailey;* ( ) *Clifton Clark;* ( ) *George Cook,* ( ) *Tom Edwards,* ( ) *Ben Elliott,* ( ) *Lee Higgins,* ( ) *Howard Jones,* ( ) *Jake McDonald,* ( ) *John Moore;* ( ) *Chester Sims,* ( ) *Sid Smith,* ( ) *Fritz Wagner*

the woman three times. Prints of a sharp heel were found on the face of the murdered woman. The person who committed the murder was most likely:

—A lover of the murdered woman.
—The wife of the murdered man.
—A political opponent.
—A fanatic reformer.

Now if you will take out your watch again and look at the group of 18 pictures on this page, you will find the twelve individuals whose photographs and names you saw in the first group. Below the cut are the names of these twelve individuals. From the group of 18, pick out the 12 persons whom you have seen before, and write the number of each of these 12 in the parentheses before the name with which it goes. Do not take over four minutes on this part of the test.

Can You Read Faces?

A third factor of considerable importance in social success is the ability to appreciate correctly the mental state back of certain facial expressions. To know the thoughts of others one must depend more on the eye than on the ear. The language of facial expression is the oldest and truest of all languages, for it is instinctive and in only a very small measure subject to the will. The would-be diplomat who is unable to tell by a person's facial changes whether he is indifferent, mildly interested, or greatly concerned has little chance of selecting the most effective means of clearing up a difficult situation.

An effort was made to measure this ability by giving a series of twelve photographs representing as many mental states. The names of these mental states are given in a list below the pictures. In the parentheses before each mental state is to be written the number of the picture which most correctly represents that mental state. It will be interesting to test yourself on the four samples which are shown on this page.

Everyday observation and good commonsense show a person that certain things work in the control of behavior, while other things are doomed to failure. One's ability to deal well with people is reflected in the correctness of his observations of human behavior. The one who is most adept at getting along with people will in general be the one who is most interested in people and who has most accurately observed their behavior. The extent to which one has profited by observation of those around him is tested by presenting the person taking the test with 30 generalizations on human behavior, some of which are correct, while others are incorrect. He is instructed to indicate whether in his judgment the generalization is true or false by encircling the T or the F in front of each generalization. You can test yourself with the following samples:

T F All men are created equal in mental ability.
T F We generally like those who bring us good news.
T F We are more shocked by our errors in etiquette than by those in logic.
T F One of the surest methods of bringing a man to your point of view is by engaging in argument with him.

The next test is devised to measure the extent of a person's social information. Other things being equal, the more things with which a person is acquainted and in which he is interested, the more able he will be to appreciate the interests of others.

In order to get some measure of the range of an individual's information, fifty statements, requiring knowledge of sports, automobiles, theaters, moving pictures, politics, current magazines, science, literature, organizations, travel, art, music, mechanics, etiquette, and items of everyday information were included. Test yourself on the following samples:

T F The nickname of the Chicago Nationals is Red Sox.
T F The term "right bower" is used in playing bridge.

WHAT EMOTIONS ARE DEPICTED?
( ) *Astonishment;* ( ) *Bashful appeal,* ( ) *Contentment;* ( ) *Coquetry,* ( ) *Delight,* ( ) *Determination,* ( ) *Grief,* ( ) *Physical suffering,* ( ) *Rage,* ( ) *Scorn,* ( ) *Suspicion,* ( ) *Terror*

T F To become a Shriner one must first join the Masons.
T F "Abie's Irish Rose" is a musical comedy.
T F The Lincoln automobile is made by Henry Ford.

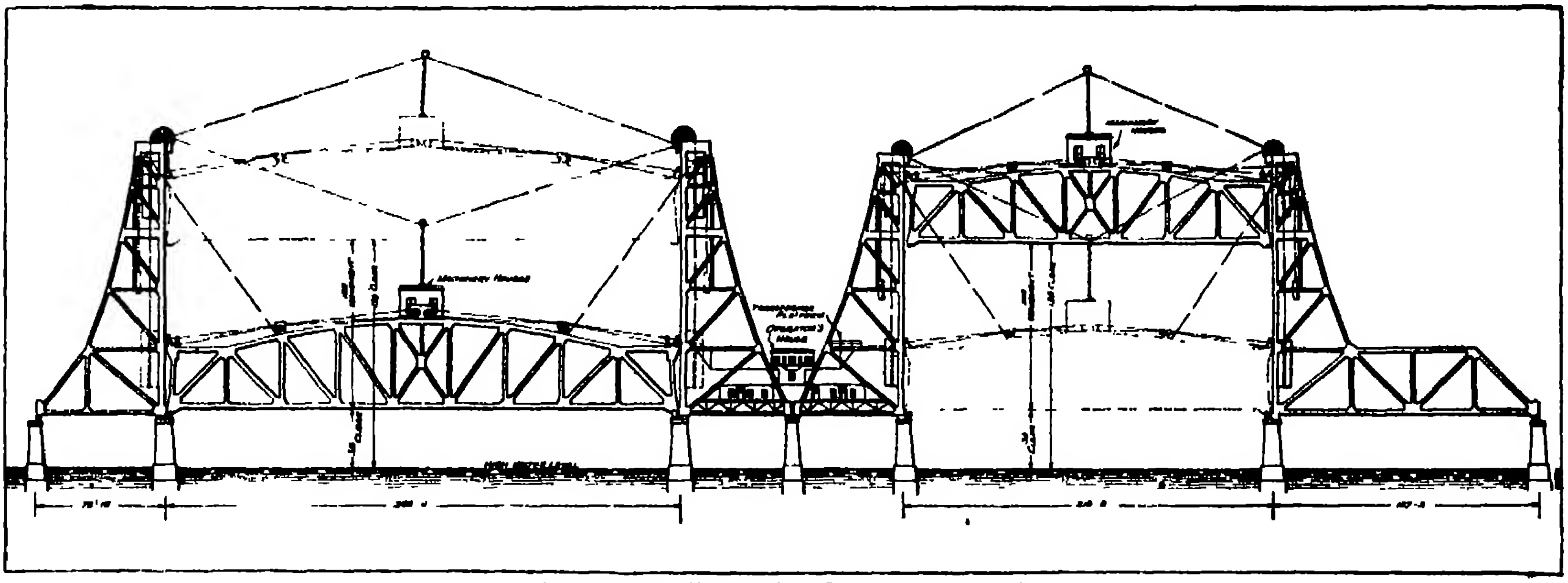
The last test measures one's ability to recognize the mental state of the speaker, or the motives back of the spoken word. It is well known that the mere words that a person says, unanalyzed, mean little, but the mental state back of these words is often of paramount importance. In order to test one's ability to appreciate the motive back of the spoken word, twenty seven quotations are given. A list of mental states, such as ambition, despair, determination, disgust, fear, hate, jealousy, love, regret, scorn, and suspicion are given. The person taking the test is instructed to write in the parentheses before each quotation the mental state or motive from the list which prompted the words. You can test yourself with the following quotations:

( ) He has a very ancient and fish-like smell.
( ) Nay then, my last hope is gone—I can fight no longer.
( ) When I make up my mind to do a thing it gets done, and this is one time that it's going to be done my way.
( ) Cursed be my tribe if I forgive him!
( ) There is something in his eyes that tells me he is not playing straight, that's why I locked the door.

Is Havelock Ellis Right?

In the preliminary analysis of test results on 1,000 college students many interesting things were discovered. For example, the average score of 500 men was about five points lower than the average score of 500 women. The highest possible score was 160 points. This is a sufficient difference to be worthy of note. To some people this greater social intelligence of women will not come as a surprise, for there have always been a few who believed in "woman's intuition," and several years ago Havelock Ellis called attention to the "greater affectability of the female mind."

Whence came this greater affectability or social sense of woman? Realizing that there can be no final answer, I shall give my opinion for what it is worth. For countless ages woman, being physically weaker than man, has had to do with tact and intuition what men did with brute strength. Being dependent upon the will of her cave man husband she found that in order to live comfortably she must be able to discern his mood with a high degree of accuracy on a moment's notice. In short, she developed her intuition from her anxiety to anticipate his wish, avoid his displeasure, and at the same time lead him into doing the things she wanted done.



A SKELETON VIEW OF THE FOUR TRACK BRIDGE
Side elevation of the two massive lift bridges of the Newark Bay bridge The lengths of the spans are 305 and 216½ feet, the total lift is 100 feet

Latest of Our Great Bridges

An Old Two-track, Timber Bridge Replaced By a Steel, Four-track Bridge 7,411 Feet Long

By J. Bernard Walker

THE obstacle presented by Newark Bay to the construction of the main western railroads to and from their terminals on the Hudson River has led to some heavy bridge construction. The best known crossing of the bay is perhaps that of the Central Railroad of New Jersey The present article describes the enlargement and reconstruction of this bridge, which is now approaching completion, at a cost of $13,500,000

At the present writing, the traffic is carried upon a double-track, pile trestle which dates from the year 1865 Originally, the railroad terminated at Elizabethport on the west shore of the bay, and passengers and freight were carried from that town to New York—a distance of 12 miles—by side-wheel steamers. In 1860, the Legislature permitted the extension of the road across Newark Bay The timber bridge was about 9,741 feet long with a draw span which provided two 75-foot openings This was replaced in 1888 by a pin-connected truss, and that, in turn, in 1905 by two double-track Scherzer rolling lift spans

Entirely of Steel Concrete

This famous old structure has been carefully maintained during its 60 years of service, but the high standard of maintenance, coupled with the growth in weight of trains, has caused the structure to be continuously rebuilt, so that long ago the original material in the bridge disappeared

Contemporaneously with the growth of traffic, there has been such an increase of water borne traffic up and down the bay, that in 1924, some 57,000 vessels passed through the draw spans and called for over 19,000 openings The underside of the deck of the bridge was so low that practically all of the boats required an opening of the draw spans in order to pass through the bridge A study of the situation revealed the encouraging fact that, if the underside of the new bridge were to provide a clearance above high water of 35 feet, about 60 percent of the traffic could pass under the bridge without requiring the opening of the draw spans

It was decided to locate the new bridge alongside of the old structure, bringing the material to the site by water, thus enabling the regular train schedule to be steadily maintained without any interruption.

The new bridge is built entirely of steel and concrete—concrete for the piers and steel for the superstructure The two openings through the bridge, which formerly were 85 feet wide, were enlarged to provide two openings of 200 feet and 125 feet, measured at right angles to the channel Each opening is provided with a pair of vertical lift, double track draw spans with a total lift ranging from 35 to 135 feet above high water. Because the ship channels lie at an angle of about 60 degrees with the center line of the bridge, movable spans were required of a total length of 305 feet for the westerly and 216 feet for the easterly channel

The decision to adopt the vertical-lift type of openings on this important main-line structure was reached only after a careful consideration of other types of opening. It was decided that a four-track,

THE MILE-LONG APPROACH
Lowering a 124½ foot, 54-ton girder into position

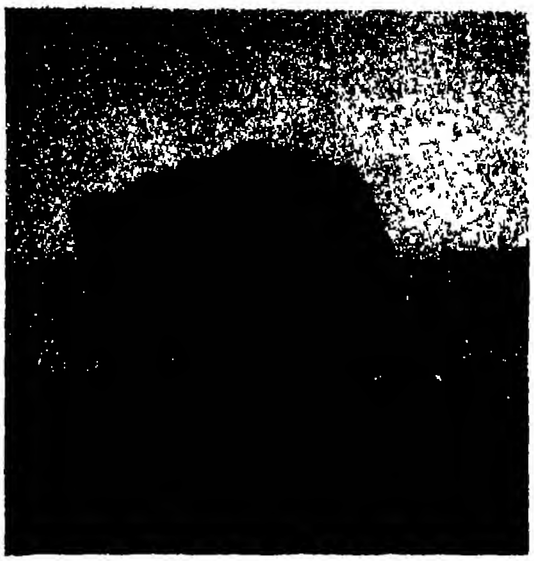
swing bridge with such wide openings would be so heavy as to involve difficult problems of construction and operation, furthermore, the War Department desired that there should be two independent channel openings—one or other of which could be used as desired This, they pointed out, would have the advantage that, in the event of one opening being temporarily disabled, the other would be available and traffic up and down the fairway of Newark Bay would not be completely shut off The bascule type was considered but it was found that it would cost about 10 percent more for the 125-foot opening, and 25 percent more for the 200-foot opening than would the vertical-lift type.

All Spans Controlled by One Man

It was for these reasons that the vertical lift type was selected—the design being prepared by Dr. J. A L. Waddell working in collaboration with the engineers of the railroad The design conforms to accepted practice, except that the counterweight cables within the steel towers are carried over multiple sheaves instead of single sheaves, attached at each corner of the bridges. It should be noted that each opening consists of two identical two-track spans carried side by side The power for lifting and lowering the bridges consists of three-phase, 60-cycle, alternating current at 2,300 volts provided with low-voltage controls

The total lift of the movable spans is 100 feet and the operating machinery is sufficiently powerful to lift the 200-foot span in one and one-half minutes, and the shorter span in one and one quarter minutes. The multiple sheave system was adopted with a view to avoid the excessive hub and axle pressures which have given trouble in previous heavy lift spans. Although the first cost is greater, there is a reduction of 25 percent in the power, and the maintenance of the system is less expensive. It is considered that this installation is a marked improvement over the old system

Each of the four spans is equipped with two 150-horsepower Westinghouse motors designed for high-speed operation. The alternating current is delivered to a substation at the west end of the bridge at



LAUNCHING A FLOATING CAISSON
These timber caissons were used in building the eighty-six piers that carry the long girder approach

26,400 volts, where it is stepped down to 2,300 volts and transmitted through two three-conductor cables to the motors. The maximum demand when all four bridges are raised simultaneously is about 1,300 kilowatts. The machinery houses are placed on the top of the individual spans All four spans are controlled by one man in the interlocking tower which is placed in the center-tower span

The spans were erected upon temporary false-work, one at a time, so as always to have one opening available for moving traffic As soon as both spans were completed, they were raised to the high positions and the false-work removed. A great saving in the weight of the spans was secured by using silicon steel for the trusses and floor beams The stringers and all other parts are of carbon steel The maximum stress in the silicon steel is 24,000 pounds and in the carbon steel the maximum stress is 16,000 pounds

Although the company will spend about $13,-500,000 on the structure and approaches, the new bridge will bring no additional revenue to the railroad, but so great is the capacity, that a large future increase of traffic can be easily handled When the bridge is opened, it no longer will be necessary to suspend freight traffic during the rush hours of the morning and evening. The train schedule calls for 240 trains across the bridge, and switching, transfer and other movements will bring the number up to a total of about 300 trains daily.

Some of the most interesting work of this great structure was done on the foundations, which included not only carrying the massive lift-bridge piers down to rock, but the construction of 84 piers for carrying the steel girders of the main portion of the bridge

In view of the great length of the bridge and the extensive reduplication of parts, the engineers made a most careful study to determine the best type of piers, the most economical method for their construction, and the best type of steel superstructure for a bridge of this character The War Department had fixed the length of the approach spans at 125 feet The soil throughout the length of the bridge consisted of sand, gravel and clay, and it was decided to form the foundation of piles driven through to rock. The cut-off was made 20 feet below low-water level, and upon this were built up the solid concrete piers

Articulated Cofferdams Used

The cofferdams were constructed upon a reinforced concrete cellular base, to which the timber walls of the cofferdam were securely bolted down The cofferdams, after being thoroughly caulked and made water tight, were floated out and lowered onto the pile foundation, and the construction of the concrete pier was then carried on by the usual methods —the cellular concrete base forming, of course, an integral part of the pier. When the concrete pier was completed, the sides of the cofferdam were unbolted and used in building other similar piers Great attention was given to the designing of this work, so as to render the building, floating, sinking and subsequent dismantling of the cofferdams as economical and expeditious as possible One manifest advantage of building articulated cofferdams was that it was possible to use the same sides many times over—some of the sections being used as many as twelve times in succession

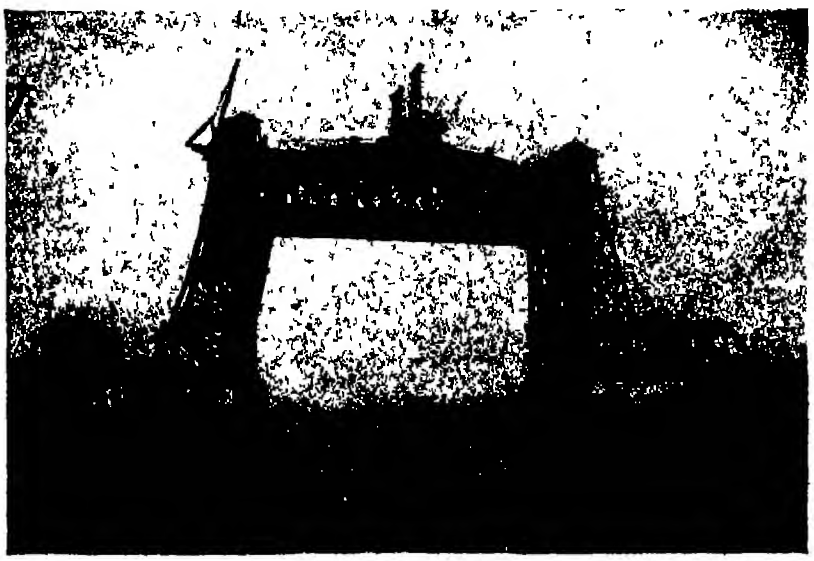
The superstructure, which is entirely of steel, called for a total of 328 plate girders, whose dimensions are length, 124½ feet, depth, 10 feet 8 inches, and weight, 54 tons The piers, for convenience, were built in two adjoining sections. There are eight girders to each double pier, or two for each of the four tracks. The footings for the girder spans are of especial interest. The fixed ends are of the hinge type, but the expansion ends make use of a single rocker in place of a nest of rollers The rocker has the advantage of simplicity in construction and greater accessibility for inspection and

THE POWERFUL FLOATING DREDGE
Much dredging was required, the material being deposited at the shore end of the bridge

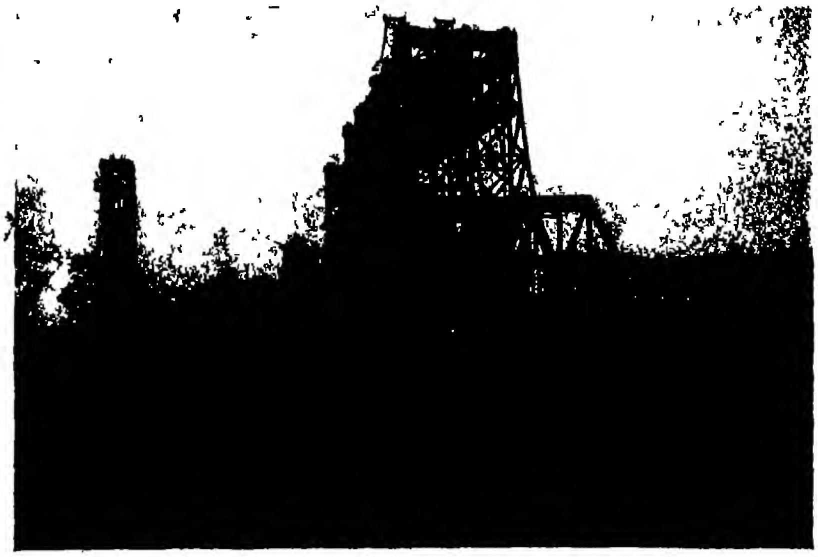
cleaning An idea of the magnitude of this part of the work is gained from the fact that the task of transporting these girders from the American Bridge Company's works at Ambridge, Pennsylvania, to the bridge called for 20 round trips of a train made up of 56 flat cars

Unlike the piers for the approaches, the all-concrete piers for the towers which carry the lift bridges were founded directly upon the underlying rock, which was found at a depth of from 50 to 70 feet. The determination to carry these piers down in solid masonry by the pneumatic system was made in consideration of the extremely heavy superstructure loads, and also of the fact that the War Department required the depth of the channel to be 40 feet These piers differ from the approach piers also in the fact that each pier is a single structure extending the full width of the bridge The caissons for each single pier measured about 25 by 100 feet The sides of the caisson were built up to a height of about 10 feet before launching It was then ballasted with concrete, towed out to the site, and then sunk to rock under compressed air

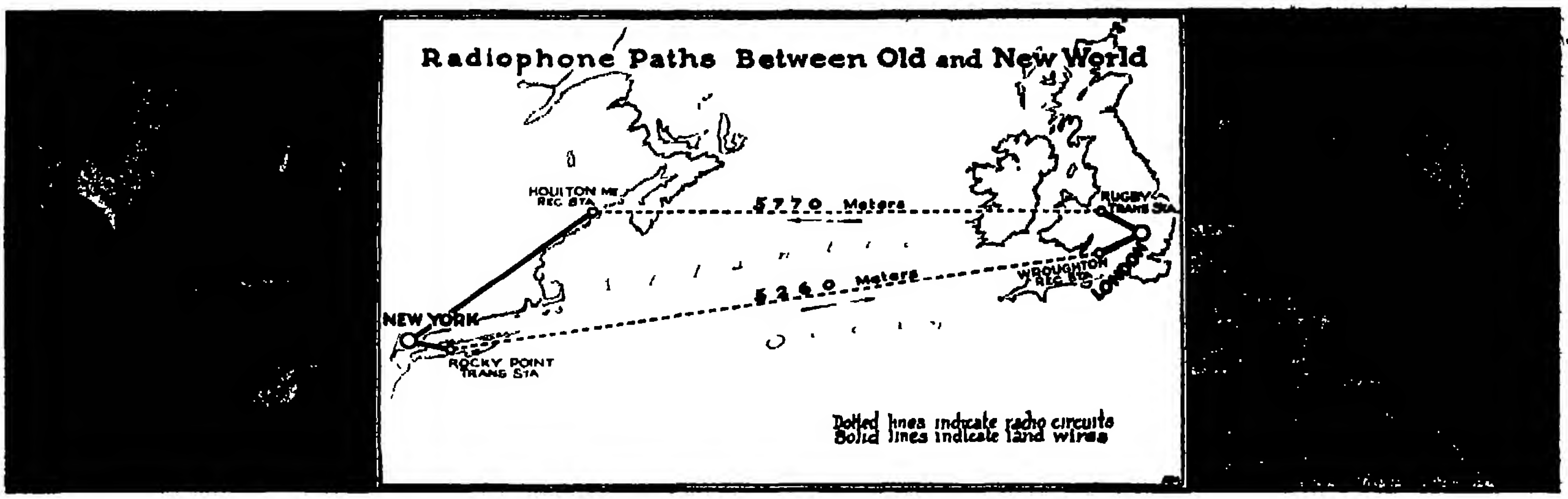
We are indebted to Mr A E Owen, Chief Engineer, and Mr J J Yates, Bridge Engineer of the Central Railroad of New Jersey for the particulars upon which this description of a very notable and highly meritorious work has been written.



OLD AND NEW SPANS
This view shows the old rolling lift span and the new 216½-foot lift in the open position



TIMBER GIVES PLACE TO STEEL
The Newark Bay bridges, old and new View looking west along the old timber bridge



NEW YORK TALKS TO LONDON

At the left is pictured a scene at the American Telephone and Telegraph Company offices in New York. The map, in the center, is self-explanatory. At the right are shown British newspaper men at the General Post Office Engineering Department, London. For four hours conversation was carried on by radio across the ocean, with perfect results recorded.

Building a Talk-bridge Over the Sea

New Radio System Is Called "Single Side-band Transmission," With the Carrier Wave Suppressed

By Orrin E. Dunlap, Jr.

RADIO engineers are building an invisible talk-bridge to span the distance of 3,000 miles between New York and London, with the ultimate aim of establishing general radiophone service between the Old and the New World.

The experiments began in 1922, and they are still in progress with no definite clue as to when the vagaries of the ether will be conquered so that commercial service can be offered to the public. Sponsors of the tests on this side of the sea are the American Telephone and Telegraph Company and the Radio Corporation of America, while the British General Post Office is in charge of the operations at the English terminal. Rocky Point, Long Island, is the site of the American transmitter and Rugby, England, is the location of the British station.

Signals from the Long Island aerial are intercepted by a receiving station at Wroughton, England, 3,300 miles distant and are forwarded to the central office in London over 90 miles of land wires. Voices can be sent directly from New York, because 70 miles of land wires link the New York office with the transmitter at Rocky Point.

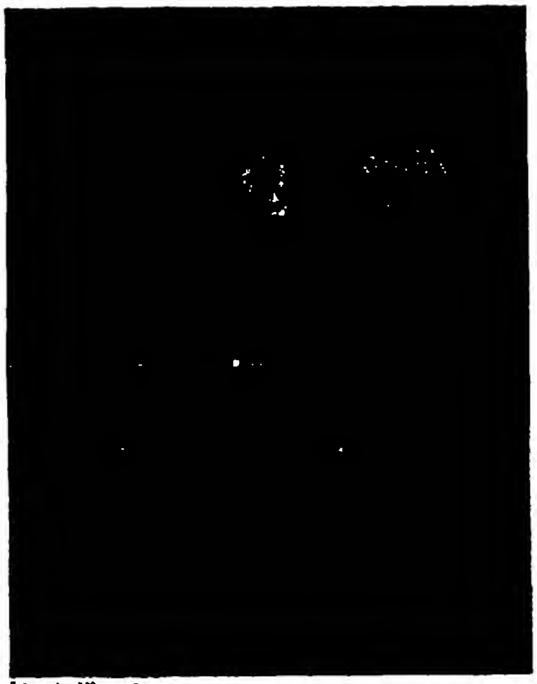
Secrecy Not Yet Practical

When the Britisher speaks in London, the words travel over wire lines to Rugby, a distance of 85 miles. The English waves are detected at Houlton, Maine, 2,900 miles from the Rugby towers. Six hundred miles of wire carry the impulses to New York. The receiving station is located in Maine because that state is one of the ideal spots in the United States for reception from European stations and there is less static interference in that locality than in the vicinity of New York.

The Rugby transmitter operates on 5,770 meters and the Rocky Point waves are 5,260 meters in length. The power outputs of both stations are rated at 150 kilowatts. The American call is 2XS and the British GBT.

Two factors which prevent the talk bridge from handling commercial traffic at the present time are static and the fact that eavesdroppers can tune in on the international conversations, thereby limiting the demand for the service. It is pointed out that any business house or private individual making a radiophone call to Europe would naturally have a message of importance and naturally the sender would not want the entire world to listen in.

Several plans have been presented and tests made of systems which scramble the waves and then unscramble them at the receiving station by means of special apparatus, thereby preventing eavesdroppers from learning the contents of the messages. When the service is finally inaugurated it will undoubtedly be protected by a method of shuffling and unshuffling the waves to confuse listeners at the international keyholes. British engineers are working on a system which lops off part of the voice at the sending station and grafts it back at the receiver.



THE TELEPHONE'S NEW FACE

These are the mouthpieces employed for talking over the ether's channel to Europe. This attachment is fitted with a microphone in place of the ordinary transmitter

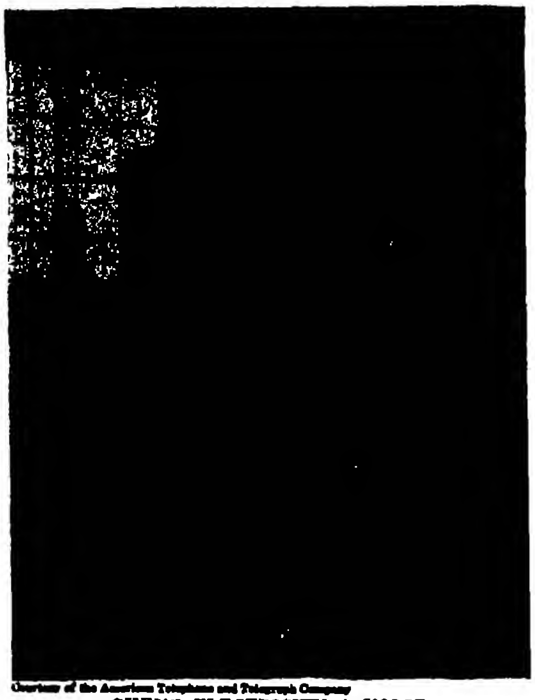
Five hundred vacuum tubes were needed in 1915 to hurl the voice across the Atlantic from Arlington, Virginia, to the Eiffel Tower in Paris, but the modern system requires only 35 tubes which produce 150 times as much power as the 500 audions which were linked in the circuit eleven years ago. This advance was made possible by the invention of a water-cooling system which prevents the bulbs from becoming hot. When electricity was applied to the old tubes they became hot after the current was increased to a certain point and the metallic elements in the lamps emitted gases which destroyed the vacuum. The modern tubes with their water-cooled jackets can handle 400 times as much current without injury to the metal parts or the vacuum.

Transmission Nears Perfection

The problem today is to reduce the mortality of words in their flight across the water. All words must be heard correctly before the system can be pronounced perfect. In the reception tests, disconnected words are used so that there is no chance of the receiving operator's imagination supplying the missing links in the sentences. During the summer of 1923 about 15 words out of 100, on an average, would survive the trip across the Atlantic. Last summer the transmission was improved so that the record was 60 out of 100 words received. On the average, during the past winter, 90 out of 100 words could be identified and during certain hours the complete word list was easily understood.

When there is a continuous band of daylight or darkness between America and Europe reception is good, but when the "sunset wall" is somewhere on the Atlantic the signals fade as the twilight creeps across the sea toward the west. The "sunrise wall" also has a detrimental effect. These barriers, which signalize sunrise and sunset, also cut off static, which to a great extent seems to originate in the tropics. Seasonal variations in the voice intensity are so great that under unfavorable atmospheric conditions it requires 10,000 times as much power to project the words through the 3,000 miles of space.

Data obtained from 40,000 individual measure-



Courtesy of the American Telephone and Telegraph Company

GIVING ELECTRICITY A VOICE

The low-power portion of the transoceanic radio telephone transmitter, including the speech input, modulating, filters and amplifying apparatus

ments in transatlantic radio-telephony revealed these principal conclusions The sun is the controlling factor in the diurnal and seasonal variations in signal strength. Transmission from east to west and west to east exhibit similar characteristics Transmission in the region bordering on the division between illuminated and darkened hemispheres is characterized by increased attenuation. Disturbances in the earth's magnetic field have a tendency to increase the daylight signal intensity and to greatly weaken the voices at night. In general, static noise is less on higher wavelengths, with the difference between day and night static apparently caused by daylight attenuation.

Full night-time signal strength is not attained until some time after sunset at the western terminal and the waves begin to weaken before sunrise at the eastern end. The daylight effects appear to extend into the period in which the transmission path along the earth's surface is unexposed to the direct rays of the sun

With the advance of the season from winter to summer, the time at which the maximum night-time value is fully attained occurs later and later. During the latter part of April the transmission path no sooner comes into ideal night time conditions than it again emerges But as the season advances into the summer, day conditions begin to develop while the night field strength is still rising. Then, as the sunlit area recedes south after the summer solstice, a time is reached, about the middle of August, when the full night-time values are returned

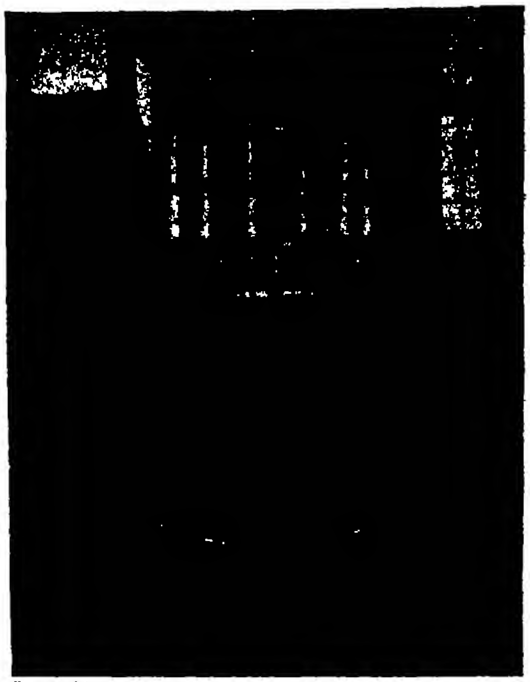
"Side-band" Transmission Used

In the development of the transatlantic circuit the engineers have introduced what is known as the "single side-band suppressed carrier" method of transmission. The ordinary broadcasting stations radiate three bands of electrical waves, which are sent through the ether The central band is called "the carrier" The one side band extends upward and the other downward from the carrier wave The former is known as the "upper side-band" and the latter as the "lower" The frequency-widths and amplitudes of each band are the same as the frequency-width and the amplitude of the original wave but the power at the carrier frequency is more than two-thirds of the total.

The transoceanic system radiates only one side band without the carrier. The advantages of this method are all the power radiated is effective in conveying the message, transmission is more stable, the frequency band is reduced, thus conserving wave-length space in the ether and simplifying the transmitting aerial problem.

The engineers explain that it is not necessary to transmit both side-bands. Therefore, in the new method one side-band is suppressed by electric filters. Furthermore, the carrier wave is merely a continuous alternating current and does not share the signal variation. It does not matter whether the carrier is transmitted or is supplied to the detector from a local source. For this reason the carrier is suppressed by filters from the modulated wave sent out from the transmitting aerial But the carrier is reintroduced in the receiving circuit from a local source. This is termed "homodyne" reception, since a wave of the same frequency as the eliminated carrier is supplied to the receiver by a heterodyne oscillator

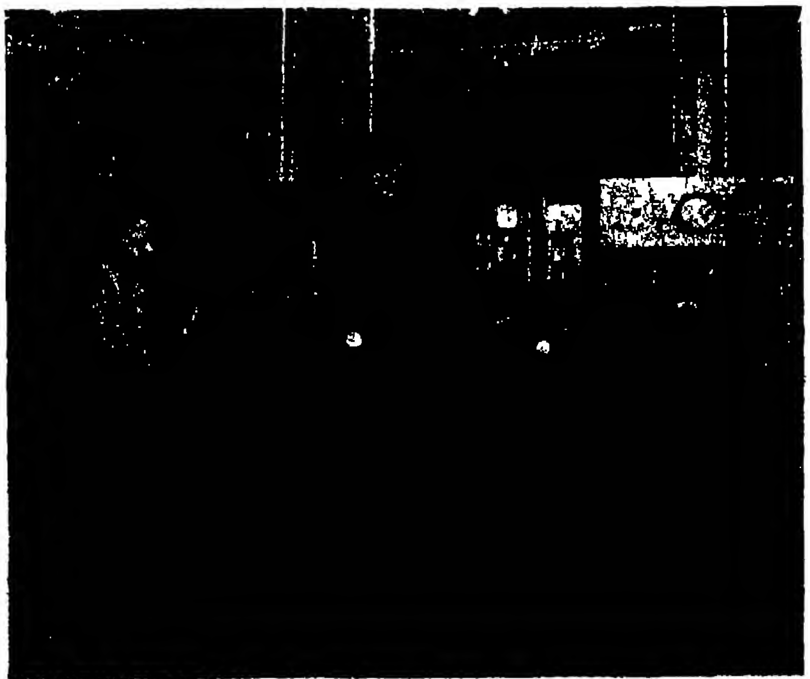
In ordinary broadcasting the energy is transmitted at the carrier frequency, at the frequencies in the upper side band and at frequencies in the lower side-band The carrier is the radio frequency modulated by the audio frequency. The upper side-band includes the frequencies extending from the carrier upward and the lower side band includes frequencies downward from the carrier In regular radiophone broadcasting the carrier frequency component comprises about 66 percent of the total power and, inasmuch as it does not convey the message, it is extracted from the side-band system Each side-band transmits the message, so that one can be dispensed with as is the case in the overseas circuit, leaving the single side-band as the pathway for all traffic.



Courtesy of the American Telephone and Telegraph Company

A POWERFUL CLUSTER OF TUBES

The circular bank of fifteen water-cooled amplifiers. The coil of hose conveys the water to cool the tubes The water circulates in the metal jackets



Courtesy of the American Telephone and Telegraph Company

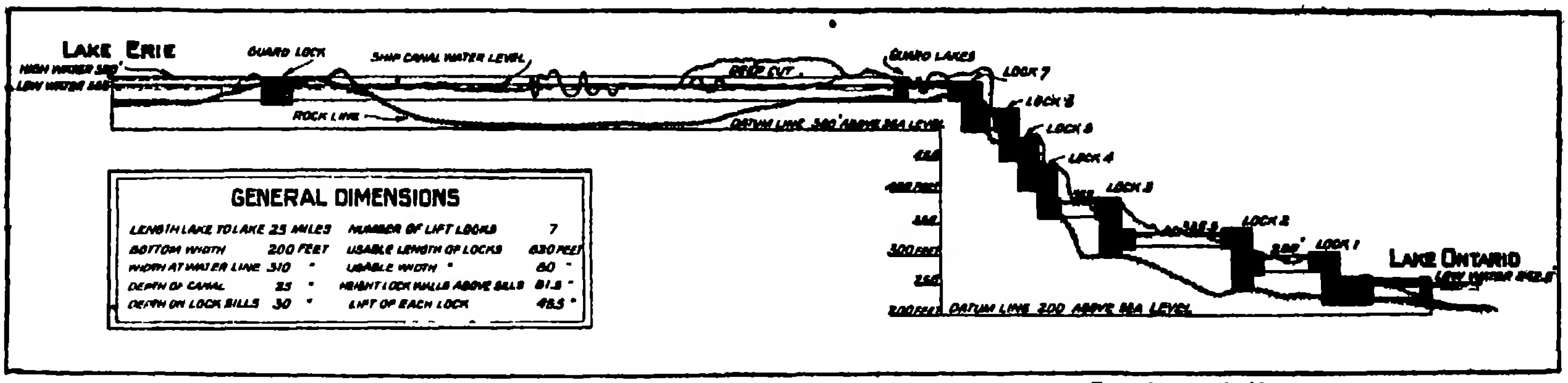
POWER SUFFICIENT TO SPAN THE SEA

The high-power section of the transatlantic installation. Two banks of the high-power water-cooled amplifying tubes are in the foreground. The output is 150 kilowatts

Courtesy of the American Telephone and Telegraph Company

WHERE RADIO AND LAND WIRES MEET

Interior of the American transatlantic radiophone receiving station. The radio receiver is at the left. At the right is the telephone testboard and amplifier for the wire circuit



PROFILE OF THE NEW WELLAND CANAL NAVIGABLE DEPTH, 25 FEET, DEPTH TO LOCK SILLS, 30 FEET, LENGTH, 25 MILES

The Welland Ship Canal

Progress on a 25-foot Waterway With 30-foot Locks that Will Open the Great Lakes to the Ocean

By J. Bernard Walker

BEFORE describing the great undertaking which is known as the New Welland Ship Canal, let us consider the topographical relation of those vast inland seas known as the Great Lakes to the St. Lawrence River and the Atlantic Ocean Lake Superior—the most westerly of these bodies of water—stands at an elevation of 602 feet above sea level Its surplus waters flow into Lake Huron through the St. Mary's River, whose rapids are overcome by the famous Sault Ste Marie locks, which include twin locks in the United States Canal carrying a maximum of 26 feet of water on the sills Through these locks, boats of 25 feet draft can pass from Lake Superior to Lakes Huron and Michigan From Lake Huron ships can proceed by way of the St. Clair River and channels dredged in Lake St Clair and the Detroit River to Lake Erie, which has a mean surface elevation of 572 5 feet Here large lake freighters must stop, for the reason that the depth of water over the sills of the old Welland Canal locks is only 14 feet. From Lake Erie, the surplus waters flow through the Niagara River and over the famous Niagara Falls to discharge ultimately into Lake Ontario, whose low water elevation is 242.5 feet. It is this great drop of 330 feet which constitutes the main obstacle to ship transit between the Great Lakes and the sea.

As matters now stand, the 14-foot Welland Canal is the only waterway from Lake Erie to Lake Ontario From Lake Erie to the sea, there are two waterways—one by way of the Welland Canal, Lake Ontario and the St Lawrence River, the other from Lake Erie, near Buffalo, to Troy on the Hudson River, and thence by that river to the sea The former route has a limiting depth of 14 feet, both in the locks of the canal and also in the various locks by which the rapids of the St Lawrence River are overcome between Lake Ontario and the port of Montreal The other canal—known as the New York State Barge Canal—has a limiting depth of 12 feet over the lock sills

ENTRANCE FROM LAKE ONTARIO
This photograph gives an idea of the massive character of the lock construction

Two Proposed Ship Canals

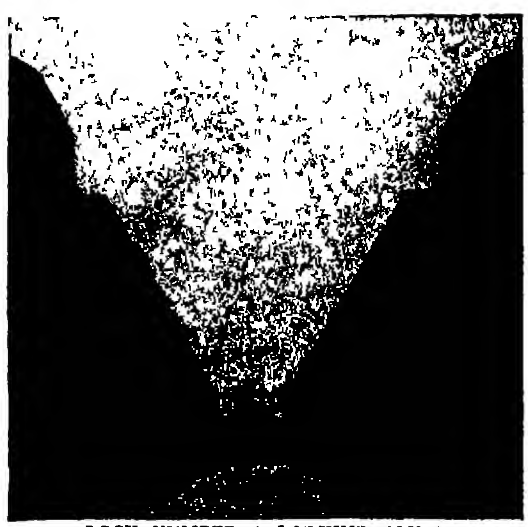
As the public is well aware, there are two projects for opening a waterway of sufficient depth to accommodate sea going ships from the Great Lakes to the sea One of these is by way of the Welland Canal and a deepened St Lawrence River, the other is by way, mainly, of the present Barge Canal and the Hudson River Since the ultimate depth of any canal is determined by the depth of water over the permanent structures, such as the sills of the lock gates, it may be said that the 25-foot waterway through the Welland Canal and down the St. Lawrence River will provide for an ultimate depth of 30 feet, whereas the route by way of the New York State Barge Canal, as at present suggested, provides for a depth of 25 feet over the sills. We think it is safe to say that, in the unlikely event of the United States Government deciding to take over the present barge canal and turn it into a ship canal, the Government engineers will take a firm stand in favor of building the permanent structures with a minimum depth of 30 feet.

A glance at any map of the region around the Niagara River shows that Lake Erie and Lake Ontario are separated by a rather narrow peninsula of land which measures in width, as the crow flies, about 24 miles. For the first 18 miles from Lake Erie, the river flows through fairly level country with a rather steep fall of the river for the last few miles. Here it comes to a great cliff or escarpment into which it has worn its way back for several miles and over which it thunders in the world-famous Niagara Falls, with a drop at the Horseshoe Falls of 155 feet and at the American Falls of 162 feet. Thence it flows swiftly down through the Whirlpool Rapids and on to Lake Ontario

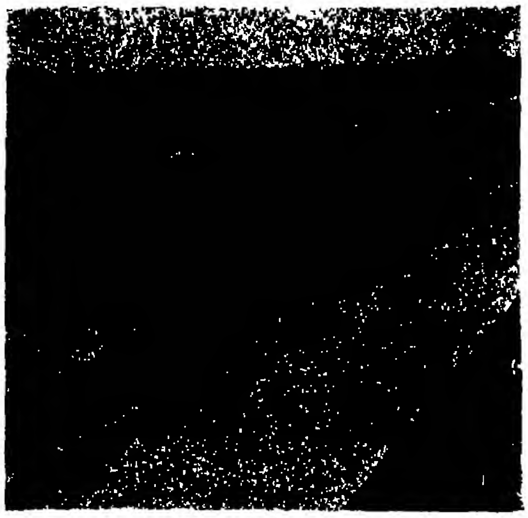
Now, if the visitor were to stroll to the westward of Niagara River below the falls, he would find that the great escarpment extends along the peninsula more or less parallel with the shoreline of Lake Ontario, and, ten miles from Nigara, he would come upon a series of imposing engineering structures representing the transformation of the old 14-foot Welland Canal into the new 25-foot ship canal—a work the magnitude of which is shown in the accompanying diagrams and photographic views.

It may come as a surprise to many of our readers to learn that the Welland Canal enterprise celebrated its centenary on November 30, 1924, and that the present 25 foot canal will be the fourth to bear that name The first, begun in 1824 and completed in 1829, had 40 wooden locks with a depth of 8 feet on the sills. In 1850, there was opened the second Welland Canal, when the number of locks was reduced to 27, built of cut stone with 9 feet of water on the sills This canal is now used for power purposes and all of its locks are still in existence In 1853, the depth was increased to 10 feet by raising the banks of the Canal and the walls of the locks.

The Dominion Government now took up the question of inland navigation and the Commission of 1870 recommended a uniform scale of navigation for the Welland Canal and the St. Lawrence route, with locks having 12 feet of water on the sills, which was later increased to 14 feet. This, the third canal, 26¾ miles in length, was opened for 14-foot naviga



LOCK NUMBER 2, LOOKING SOUTH
All the locks of the canal are 30 feet deep, 80 feet wide and 820 feet long



PORT COLBORNE BREAKWATER
This photograph shows a stretch of the complete concrete superstructure of the great breakwater

tion in 1887 and the St. Lawrence River canals were placed in service in 1901. This canal has cost for construction about $24,000,000 and about $12,000,000 for repairs and maintenance. The Welland and St. Lawrence Canals between Lake Erie and Montreal have cost Canada about $87,000,000 on capital construction, and about $28,000,000 for repairs and maintenance.

In 1901, the total tonnage passing through the Welland Canal was about 620,000 tons. By 1914, it had increased to 3,860,000 tons, showing that, due to increased facilities, the St. Lawrence route had gradually drawn more heavily upon the Great Lakes Atlantic seaboard trade. The Great War withdrew many lake vessels into high sea service, and traffic through the Canal fell off from 3,860,000 tons in 1914 to 2,200,000 tons in 1918-19, but since this latter time, traffic has been growing rapidly year by year, with a new maximum annual tonnage record of 5,037,412 tons, established in 1924.

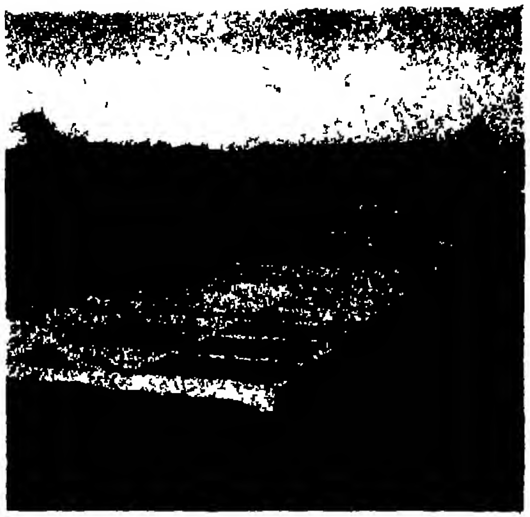
The short-sighted policy of 1870 left the Welland Canal as much out of date in 1887 as it was when the improvements were begun in 1873, whereas a moderate increase in the length of the locks alone would have enabled a large part of the fleet of 1901 to descend to Montreal, instead of being confined to the Upper Lakes. These canals, locks and river channels are entirely inadequate for use by the Great Lakes steamers of today, and can now be considered as of little more than barge size. The improvement of the Welland and St. Lawrence Canals to such dimensions as would accommodate ships of at least 25 foot draft has been contemplated for many years. During the past quarter of a century, exhaustive surveys have been made to determine the feasibility and cost of such a waterway and another survey has been carried out recently by the International Joint Commission. Following the opening of the St. Lawrence Route in 1901 for vessels drawing 14 feet of water, the Canadian Government began improvements to the Port Colborne entrance of the Welland Canal, these consisting of deepening the harbor to 22 feet, constructing a million bushel modern concrete elevator (completed in 1908), and building large breakwaters. So great has been the increased movement of grain through the Welland Canal, that the Dominion Government has twice found it necessary to add to the original Port Colborne elevator, first in 1912-13 and again in 1923-24, each addition increasing the capacity by one million bushels. The elevator and its extensions are already taxed to the limit of their 3,000,000-bushel capacity.

The total length of the new ship canal is 25 miles and the difference in level between Lake Erie and Lake Ontario is overcome by seven locks, each having a lift of 46½ feet. The topography of the lower plateau and the fact that the canal extends in a direct line down the face of the escarpment permitted the adoption of lifts of this height. They are a peculiar feature of the design of the canal, and there was no precedent in any previous construction for locks of their size.

Total Cost About $110,000,000

The cross sections of the canal show that it will be 200 feet wide on the bottom with slopes of two feet horizontal to one foot vertical. The sections which were let by contract in 1921 have been excavated to a depth of 25 feet, but the rest of the work is being carried down to a depth of 27½ feet. All masonry structures, however, are being built for a draft of 30 feet. Hence the canal, whenever it is so desired, can be deepened by simply dredging out the canal prism and the harbor entrances. Port Weller on Lake Ontario and Port Colborne on Lake Erie are now being dredged to give a 27½ foot draft where severe wave action may be expected.

The canal has seven lift locks and one guard lock, as shown on the accompanying profile. Three of these are twin locks in flight, arranged similarly to the Gatun locks of the Panama Canal. The locks will have a usable length of 820 feet, a usable width of 80 feet and a depth of water on the sills of 30



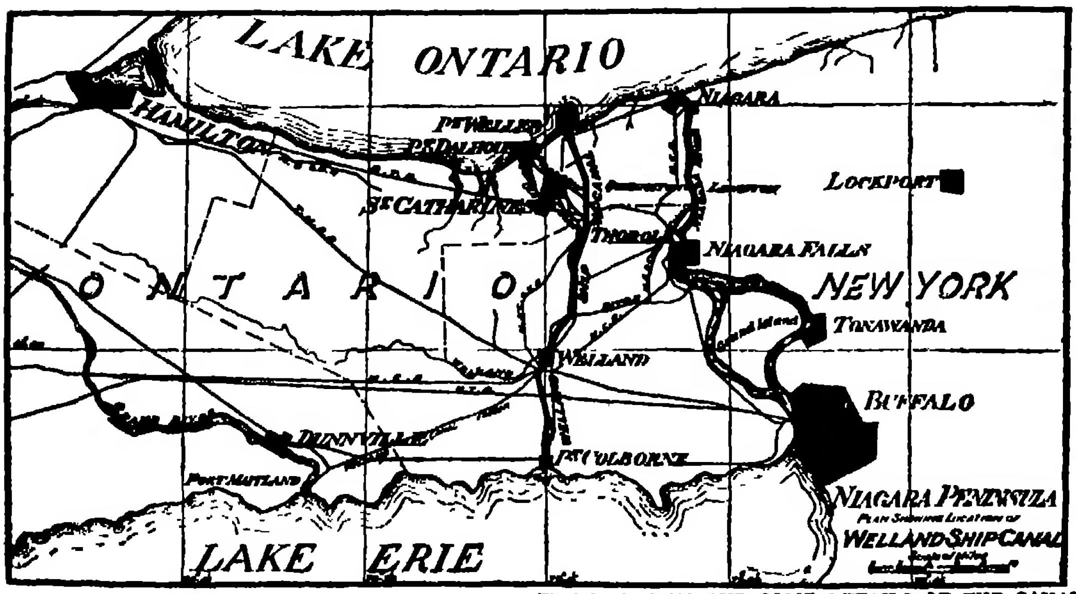
BREAKWATER AT ONTARIO ENTRANCE
The concrete, rock filled cribs upon which the concrete monolith superstructure was erected

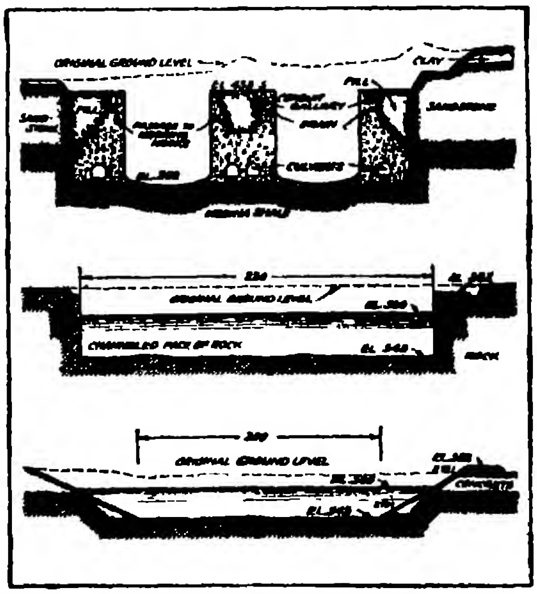
feet, the lift of each lock being 46½ feet. For the 25 foot depth, the width of the canal at the waterline will be 310 feet. The lower mitre gates are 82 feet high, and the approximate weight of each leaf is 425 tons. The total estimated weight of metal in the lock gates and operating machinery is 12,300 tons, and the estimated motor load for operating the canal and the Port Colborne elevator of 3,000,000 bushel capacity, is 11,200 horsepower. It will take eight minutes to fill a lock, and the estimated time for a vessel to pass through the canal is eight hours.

In addition to the work on the canal itself, there has been some very heavy construction for the harbors at each end, notably at Port Colborne, where massive breakwaters were required to protect the approach to the canal.

The expenditures to the end of March, 1925, on the new canal had reached $50,000,000, including the engineering expense and the purchase of the right of way. It is estimated that the canal will be ready for operation about 1930, when the total cost will have been about $110,000,000. We are indebted for our data and illustrations to the courtesy of Mr. Alexander J. Grant, Chief Engineer of this great work.

In an early issue will appear an article on the first decade of operation of the Panama Canal, which was opened to traffic in 1914 and has a most romantic history





THE LOCATION AND SOME DETAILS OF THE CANAL
LEFT: *Map showing relation of the Welland Canal to Lakes Erie and Ontario, and to the Niagara River.* RIGHT: *Sections through twin locks and through canal in rock and in earth*

THE PERFECTION OF NEW PROCESSES OFTEN MEANS MONTHS OF RESEARCH AND EXPERIMENTATION

A Romantic Achievement in Industrial Chemistry

A Paint Which May Be Applied Quickly, Will Dry Rapidly, Is Tough, Hard and Resistant to the Elements

TODAY nearly three million automobiles are finished with a substance which is neither paint, varnish nor enamel, but which combines and enhances the qualities of them all. Millions of dollars worth of fine furniture, private railway cars, day coaches, pianos and even tank cars have a similar finish Up to six months ago it could only be applied by pneumatic spray guns. Today it can be brushed on in the home. Unlike the finishes which have been standard for generations it is not made from gums and oils with a turpentine thinner It is a new development of nitro-cellulose with butyl alcohol, distilled from grain, as a solvent.

A Task for Pioneers

St. Gaudens said that a sculptor was a man who mixed brains with clay The corps of chemists who created this finish were pioneers They mixed years of painstaking research and experience with cotton-nitrates, solvents and pigments. They modified every ingredient and in some cases they actually synthesized wholly new compounds to serve as ingredients. Then they purified, perfected and amalgamated all of the ingredients into a finished product.

Today, the substance which they created is used around the world. This, in brief, is one of the latest romances of industrial chemistry

A "paint" was wanted that would have all the advantages of the old varieties, with none of the disadvantages. It must be compounded so that it could be put on quickly, so that it would dry rapidly, but so that it would stay permanently, and wear indefinitely without loss of lustre or protecting power. And there were, apparently, no beaten paths to follow—no products that might merely be improved

Dr. Charles M. A. Stine, Chemical Director of E. I. duPont de Nemours and Company in Wilmington, Delaware, under whose direction it was developed, thus describes the inception and production of this most important commodity.

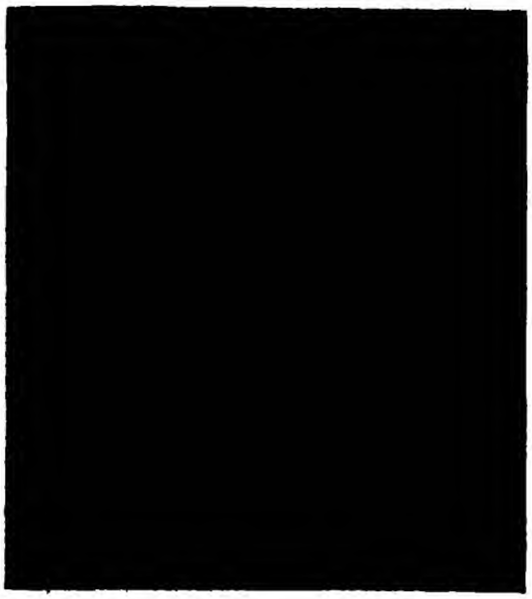
"In effect, we were told that what was wanted was a finish that would protect cars, furniture, and other finely finished objects The paint, or lacquer, or enamel, or what-not, that we were to develop must be as handsome when it was applied as is the finest finish ordinarily used Yet it must be capable of much more rapid application It must be capable of carrying color pigments or other coloring matter, so that various shades might be readily obtainable, and these colors must not fade. When dry, the desired product must be hard, so that it would not scratch, must—in this particular—be similar to glass. Yet it must not have the other properties of glass, lest it crack too easily. Therefore, with its hardness, it must be tough. Furthermore, it must be proof against the action of water, against oil, against grease, and against the action of such acids as might come in contact with it It must not deteriorate under the action of heat or cold. Ice and snow, sunlight, dust, sandstorms, or mud, must leave, if possible, no mark at all And of course, the product must be able to compete in price with the finishing compounds in ordinary use.

ACCURACY OF DETAIL
Is essential where reactions depend on precise formulas

Requirements Were Stringent

"What this new finish was to be made of, no one cared. But of certain things we were sure. It must be made of such mixtures as would not eat their way through tin cans, for example, for tin containers would be necessary for its shipment and storage, and the paint would be worse than useless if it ate through the tins and trickled all over the shelves. Neither must it undergo any chemical changes after it was prepared, for that might change the final result. Then, too, it must have good 'covering power.' That is, it must not be transparent, except when used as a varnish, for part of its job is to hide the color and texture of the material over which it is to be spread. And there were many other qualities that it must or must not have. And with these specifications we set to work."

The development of this new finish began with nitro-cellulose. When nitrated cotton is dissolved in amyl acetate and put on a surface it dries very quickly. It is commonly used as a coating to protect lighting fixtures, fine hardware and silverware from tarnishing. But so thin is this protecting film, when the solvents evaporate, that despite the fact that it is very hard and very tough, it has not the



PLACED IN NITRATING TANKS
The clean linters receive the first process step

"body" to stand up under hard usage or to wear well.

This lacquer had many of the properties which the chemists were seeking. Could the chemists make a similar solution containing several times as much nitrated cotton, and thus make a film several times as thick when the solvent has evaporated? This was one of the many problems.

Chemists tried that, but it did not work. They put in more nitrated cotton, but immediately the solution became more or less jelly-like, and there was no way to spread it out smoothly. Formerly it was thin enough to use, but it left too thin a coat. Now it would leave a thick coat, but it was too thick to spread.

For a long time the experiments seemed to stand still, or at best to progress very slowly, and then an accident occurred, which provided the romance which sometimes relieves the patient drudgery of a chemist's life.

An Accident Leads to a Discovery

A new batch of this thick stuff had been assembled and was in a large container ready to go to the mixing machine. It was summer time. The laboratory was warm and, as a matter of experiment, some caustic soda had been put into the mixture. But just as the jelly was about to be put into the mixer, the machine broke down. It was difficult to repair it, and the container with the compound stood idly by for several days while repairs were under way. Finally, when the mixer was in working order again, the container was wheeled out, the lid was taken off, and to the amazement of everyone the jelly-like mass had become almost as thin as water, and almost as clear. Here it was, apparently—the very stuff for which the chemists had been looking for several years.

Why it was thin the chemists did not know, but after all, the *why* was less important than the *how*. So they investigated, and found that apparently certain chemicals, together with the summer temperature and the waiting, had rearranged the molecules somehow or other, and had thus changed the consistency of the mixture.

The next test was to see if it worked; and after much experimenting it was found that while it could be spread, while it dried very rapidly, and left a heavy film, it was impossible to use it satisfactorily with a brush, for when it dried, the brush marks were plainly to be seen. Further experiment, however, proved that with a spray gun it could be applied perfectly.

But here another problem presented itself.

Everyone knows that when there is rapid evaporation, there is a decrease in temperature. But where there is a rapid lowering of the temperature, there is often a condensation of the moisture in the air. So, when this mixture was applied, it dried so quickly as to lower the temperature of the surface on which it was spread, and that, in turn, sometimes caused the moisture in the air to condense, with the result that the water often discolored the coating of "paint."

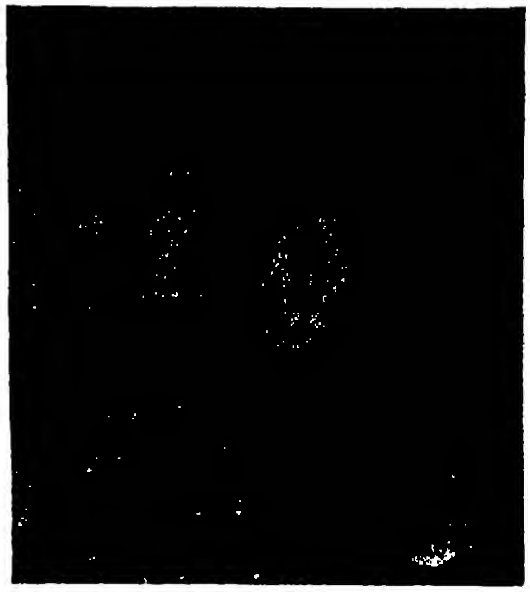
So the mixture had to be prepared in such a way that while it would dry quickly by the evaporation of the solvents and would deposit the desired clear film very rapidly, the moisture which might condense on the chilled surfaces, especially in the summer time when the humidity is very high, must not damage the finish by producing an opaque, milky appearance of the freshly painted surface—"flushing" as it is called.

It was found that this hazy, milky appearance of the surface, was due to the dilution of the solvents in the mixture by the water condensing out of the air and mixing with these solvents. This difficulty was overcome by slowing up the evaporation of the volatile constituents of the paint as well as by increasing the solvent power of certain of the ingredients used, so that the addition of small amounts of moisture would not affect the appearance of the finished film.

DEHYDRATED AND PRESSED INTO CAKES
The nitrated cotton is relieved from the bottom of the press

"With that accomplished, the new compound was a long step on its way to perfection," Dr Stine explained. "When applied, it became hard and very tough. It was not affected by ordinary acids or alkalis, such as road tar and certain types of dust and mud which contain lime or sodium salts. In the West there is enough alkali (sodium carbonate and carbonate of lime) in the dust to actually injure a finish not properly compounded. But it was necessary to find out just how hard and tough and resistant it was. Furthermore, it had to be colored, and the colors had to be carefully chosen. The pigments must not settle so as to make it hard to mix them thoroughly when the compound was to be used. And, of course, the pigments must not fade."

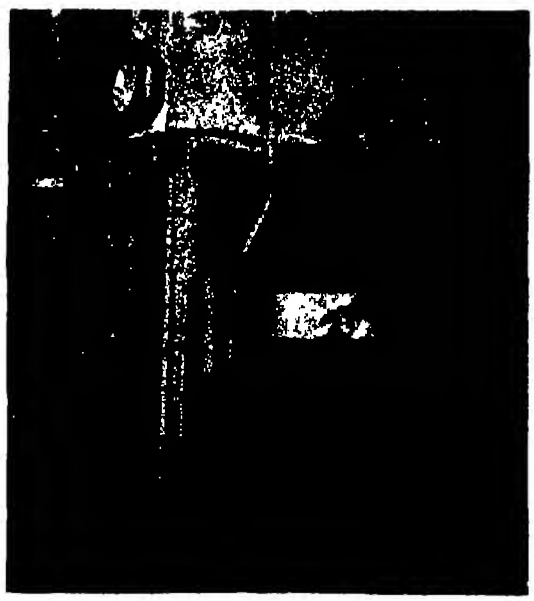
This necessitated a lot of experiments and tests. And the tests necessitated the development of a lot of strange contrivances. To find out if the finish would fade, panels of wood and metal were painted with it and were put on the roof. But that was not satisfactory, for they would have to remain there for a couple of years before the tests would be conclusive. Already several years had been spent on the task, and no one was in the mood to sit and wait for a few samples to fade on the roof. So an apparatus was designed wherein samples were arranged around an ultra violet light and automatically immersed in containers of water where they were soaked for definite periods, then exposed again to the eye of the ultra violet arc so that the heat and light played on the wet surface. This was so powerful that in a week or two the normal effect of two years in the sun was obtained.



CLEAN COTTON LINTERS
Being placed in the top of a powerful press

In this light, the first painted panels exposed not only faded, but when examined under a microscope, exhibited certain incipient cracking which was considered as indicating ultimate failure.

In fact, a regular part of this test is to examine with a microscope the panels which have been exposed to the artificial sunlight and the artificial rain storms, in order that the incipient failure may be detected long before it becomes visible to the naked eye. Many finishes are said to have "failed" when, to the unaided eye, they still appear smooth, unbroken films, but the searching eye of the microscope reveals the beginning of the formation of minute cracks and crannies between the grains of the film which, perhaps, months later might develop into actual failure of the finish.



NITRATED COTTON LINTERS
Are treated by several processes until assimilated

TESTING THE PAINT
In a violet ray, automatic weather producing machine

These initial failures were a serious disappointment, but they served merely to emphasize the value of the accelerated weathering test and to set for the laboratory the task of learning how to avoid this incipient failure. In some cases, the difficulty was due to the pigments employed They were not properly compounded Back the chemists went, to work on the pigments, and they produced a whole new set This time the ultra-violet light and the artificial rainstorms had no effect whatever The color remained the same and the film was durable The tests prove only that at the end of a year an automobile finished in this new composition is likely to present a better appearance, so far as the finish is concerned, than it presented when it was new

But there were other things to find out about it It was hard, of course, but just *how* hard? At first they tried to scratch it with their thumb nails Then they rigged up a machine to cut it with a sharp blade, measuring the pressure required But the incision tended to close after the blade was lifted out, and so the results obtained were not accurate And so the experimenters developed a different kind of apparatus

A balanced scale was made On one of the arms was a perpendicular column, on top of which a ball bearing was placed On the other arm a platform was built to hold weights. Now samples of the clear, uncolored enamel are spread on glass and allowed to dry These samples are turned upside down, and placed on a support over the ball-bearing A weight is placed on the other end of the scale, pushing the ball bearing up against the enamel The diameter of the dent made by the ball in the film is measured with a microscope and the hardness of the film can be measured by the weight necessary to make the dent a certain diameter Another test uses steel plates finished with this paint, which are chilled and then dented on the reverse side This finish must survive blows which may crack the steel but not the finish!

But how tough is it? And how can toughness be measured?

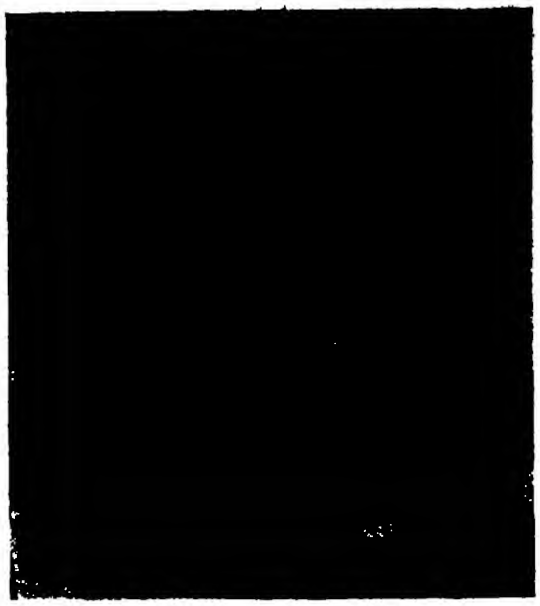
Durability Tests by Special Machine

Coats of the film are spread on sheets of tin. When the mixture has dried it is peeled off the tin, and a stamping machine cuts pieces from the strips. These pieces are all cut the same size so that the results may be compared. Clamps take hold of the ends of this thin film, and tension is put on them The amount of force necessary to break the film is measured, and the experimenter learns how tough the film is This same apparatus is used to measure resiliency How far can the film be stretched, in other words, and how much will it tend to resume its former shape?

It is obvious to anyone that the material dries quickly But how quickly?

At first, a coat was spread and someone stood by with a watch and touched the sticky surface from time to time, until his finger no longer made a mark But now a disk of glass is painted, and is instantly put on a revolving plate Over this is a sand box, from which pours a fine stream of sand The sticky disc revolves, and the sand is directed on it in a spiral By a simple timing device the time of the revolutions is noted, and after the film has dried, the glass disc is taken out and shaken The sand that has fallen on the film after it has dried flies off, and a gradually fading spiral of sand shows how long the drying process took.

It takes 13½ hours to paint the body of one make of automobile with this new finish Formerly it took 336 hours with ordinary varnishes and enamels The labor costs less, and the costs for materials have been decreased as well Because of the increased speed in handling cars in the automobile paint shop, the number of bodies tied up in the process and the space necessary for them have been reduced 75 percent. Through the saving thus brought about, one big manufacturer of medium priced cars was enabled, recently, to reduce considerably the price of his product

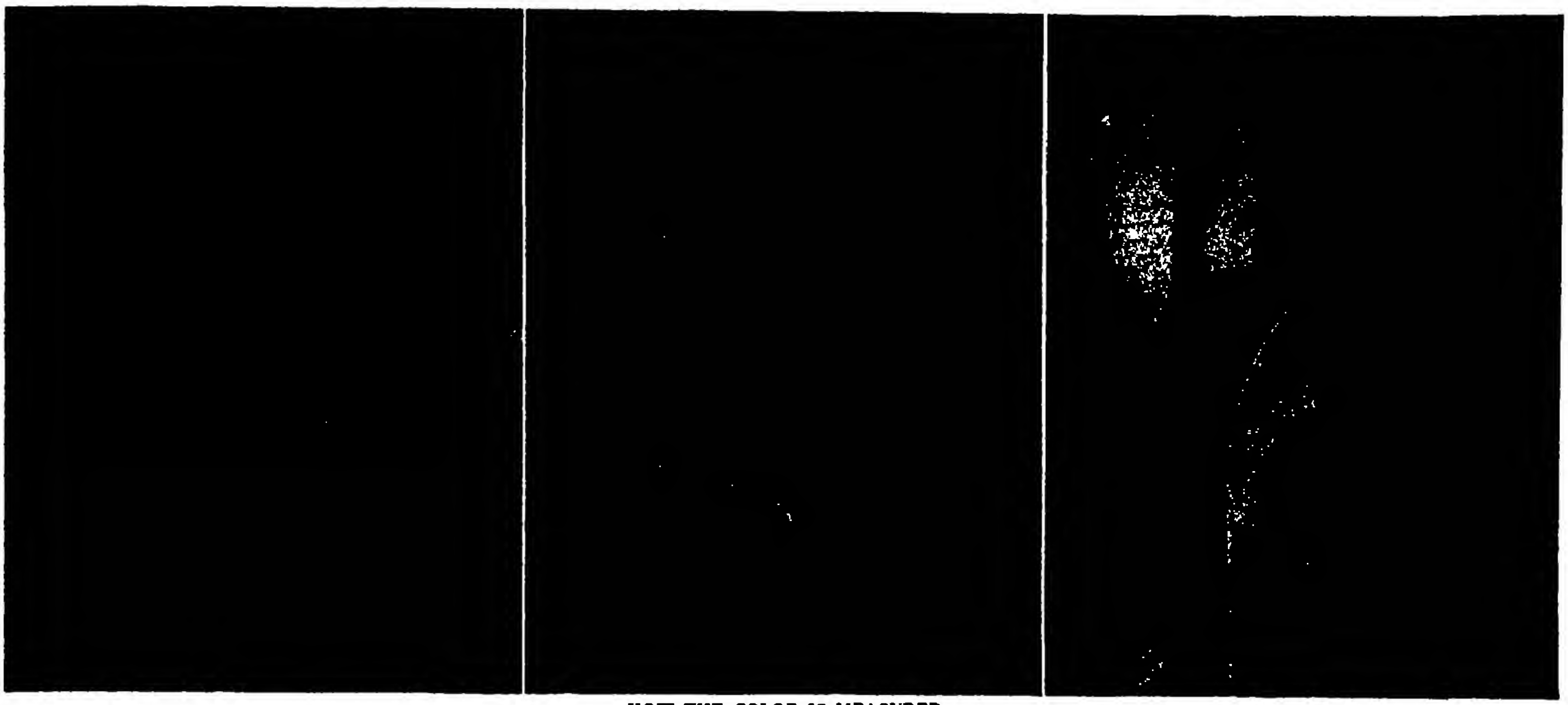


CONSTANT TEMPERATURE ROOM
Where tests are made for toughness and durability

The success of this new finish, which was rapidly adopted by the automotive, furniture and railroad industries, created a public demand for a product which could be used in the home. Few of us have enough work to do in painting the kitchen chairs or the baby's hobby horse to warrant putting in a spray gun and an air compressor! Consequently, work was begun on perfecting a "brushing" product similar, in its final effect, to the spray-gun product It took two years to do it, but it is done—done too, after many unsuccessful experiments that finally set Dr Stine and all his assistants to work, toward the end of 1925, with their sleeves rolled up and their coats off—working evenings and Saturdays, holidays and Sundays—for four energetic weeks At the end of that time, they rolled down their sleeves again, and emerged from the laboratory with a new finish and laconically announced that here was a finish which had passed the chemical tests but would have to be tested in actual use Then this was done, successfully, too. Truly romance lurks even amid the exactness of the chemical laboratory, if we can but find it.

SPRAYING PAINT ON A RAILROAD CAR
In the railroad service the practical utility of this paint has been fully proven

TESTED BY RAIN AND SUN
The finished product is tested under service conditions for permanent pigmentation



HOW THE COLOR IS MEASURED

LEFT The container with the hay is attached to the apparatus CENTER Adjusting the color disks on the shaft RIGHT The hay and color disks are revolved after matching

Measuring the Color of Hay

Definite Standards of Color Have Been Formulated for Use in Grading Hay

By O. M Kile

"COLOR sells hay," is a common expression among hay dealers What they mean is that hay which retains its natural green color usually has more feeding value and brings a better price than other hay.

But how to determine color accurately was a troublesome problem to hay experts of the United States Department of Agriculture, who were seeking to set up standards by which hay might be graded "Light green" or "medium green" are expressions which may mean entirely different things to purchasers or even to official inspectors of hay

By an ingenious application of the Munsell Color System, worked out by K B Seeds and his associates in the Department of Agriculture, local inspectors may now determine color values accurately and definite color standards have been set up

Hay of Composite Color

For applying the Munsell system to practical use, disks are provided whose color values according to the Munsell system are known, and which include the five primary colors, red, yellow, green, blue, and purple, and five intermediate colors, yellow-red, green-yellow, blue-green, purple-blue, and red-purple. When two or more of these disks are spun on a motor shaft at high speed, the colors of the exposed portions blend into one composite color By trial and error in the selection of the various disks and changes in the amounts displayed, any color can be matched The measurements for this color according to the Munsell system can then be calculated from measurements of the exposed areas of the various standard disks used in making the match.

Hay does not have a solid color but is composed of many plants having wide color variations. These various colors must be blended into one composite color before the color of the hay can be measured by the Munsell system. To obtain this composite color a machine was devised in which a portion of the hay is spun at high speed The Munsell disks are spun simultaneously on the shaft of the apparatus Thus the composite color of the hay may be compared with the composite color of the disks

This machine and the methods employed in its use are shown in the illustrations When it is desired to measure the color of the hay in a bale, the bale is opened, portions spread on a table, and a representative portion selected from the lot by trained investigators of the Department This wad of hay is then placed in the metal container, the

THE WIRE SCREEN

In the center of the circular wooden cover, a wire screen presses tightly on the hay to prevent loss of leaves

circular wooden cover is placed over it and the container and cover locked together with thumb screws in such a manner that the wire screen in the center of the circular wooden cover presses tightly on the outer surface of the hay to prevent loss of leaves. This container is then fastened to the front of the machine with the shaft through the center of the hay The operator next selects the disks which he believes will produce a composite color matching the hay and arranges them on the threaded end of the shaft in the center of the hay

Used in Grading Hay

The disks and hay sample are then rotated at a speed of about 1,200 revolutions per minute. The illustrations show how the various colors of the hay and of the disks blend into concentric rings of composite color at this speed The operator notes the relative composite color of the disks and the hay The apparatus is stopped and if a perfect match is not obtained at the first trial the disks are readjusted to display such different amounts of the various colors as seem most likely from previous experience to bring about a perfect match. This process is continued until by trial and error the perfect match is obtained. The operator then measures the size of the segment displayed of each disk used in matching the hay From the figures thus obtained the hue of the hay according to the Munsell Color System is easily calculated by means of a definite formula

Samples from hundreds of bales of each kind of hay have been measured in this way by specialists of the Department As a result of these color investigations it has been possible to formulate definite standards of color for use as a grading factor in the standardization of the most important kinds of hay

This device for measuring the color of hay may be used for measuring the color of other commodities with certain modifications to adapt it to their varying physical requirements

MULE POWER IS USED FOR TRAM CARS TO GET BANANAS FROM THE PLANTATIONS TO THE MAIN LINE OF THE RAILROAD

Agriculture in the Tropics

In Actual Production of Food Value per Acre of Land Cultivated, the Banana Exceeds Wheat or Any Other Crop

"POPULATION has a tendency to increase faster than food," wrote Thomas Robert Malthus when the United States had a population of almost five million Now that we have an estimated population of 120,000,000, the struggle for existence is far more real than it was in 1800, when the thinking men of the world had begun to appreciate the truths stated in the Malthusian theory

There is, however, one saving grace in the situation—and that is the increased facilities for transportation by railways and steamships which make it possible to transport food quickly from one part of the world to another. If we except those remote districts of Asia where modern transportation methods are unknown, it is impossible for starvation to occur today, for in the event of disaster, radio and telegraph would carry the news far and wide, when swift steamships and railways would unload supplies almost before the victims of fire, quake or failing crops would be more than unpleasantly hungry.

A Staple Food in the Tropics

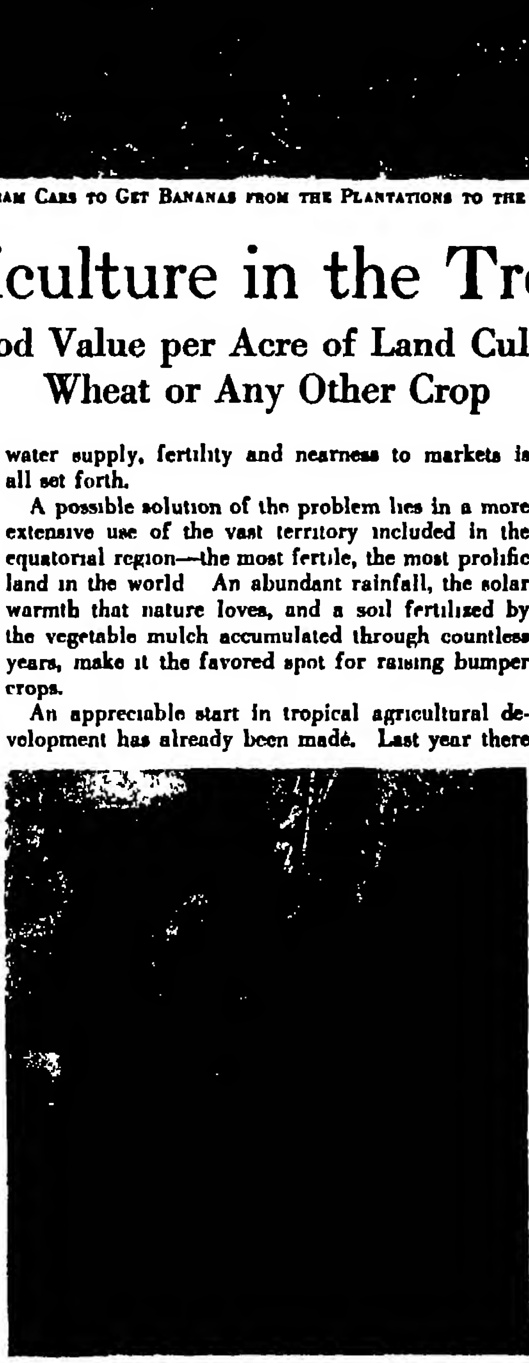
But in order to have necessities, it is first necessary to produce them, and the most important quest in the world today is that for virgin territory where additional commodities may be raised in order that the mounting millions of the world's population may be cared for.

Our own west, the steppes of far-away Russia, the llanos of the Argentine, the fertile spots of Africa are on the way to contributing their quota Still the cry is for more arable land. Where shall it be found?

There remains no "terra incognita" Practically every foot of the land surface of the habitable globe has been accounted for and information regarding water supply, fertility and nearness to markets is all set forth.

A possible solution of the problem lies in a more extensive use of the vast territory included in the equatorial region—the most fertile, the most prolific land in the world An abundant rainfall, the solar warmth that nature loves, and a soil fertilized by the vegetable mulch accumulated through countless years, make it the favored spot for raising bumper crops.

An appreciable start in tropical agricultural development has already been madé. Last year there were imported into the United States 28,225,556 stems of bananas—1,328,688,267 pounds of this delicious tropical fruit which is as sustaining a food as the familiar potato, and which reaches the ultimate consumer in a wonderful germ-proof package designed by nature herself. In addition to the number of pounds brought into the United States, an enormous quantity of this fruit was imported into Europe where, year by year, bananas are becoming more popular.



CUTTING INTO A BANANA PLANT
Note the exceedingly porous character of the wood

The banana is not a luxury It is a staple food. Together with its near relative, the plantain—*musa paradisiaca*—it constitutes the chief source of carbohydrate food of enormous numbers of people dwelling in tropical countries; and it occupies in their dietary the place taken by potatoes and such cereals as wheat, rye and barley in the rations of dwellers in the temperate zone.

Rich in Food Value

Estimates by various authorities show that in actual production of food value per acre of land cultivated, the banana exceeds wheat or any other crop For this reason, the banana affords a valuable addition to the standard food supply and its greater utilization will help to solve the economic problem of how to supply the world's increasing millions with a staple food which is obtainable at all seasons and at a reasonable cost.

In addition to its carbohydrate content, the banana also contains other essential food elements, namely, mineral salts and vitamins and, in small quantity, protein and fats. In flavor as well as in food value it easily heads the list of fresh fruits. In energy value and tissue-building elements it surpasses most vegetables. Judged by these standards, the banana costs less per pound at all seasons than any of the

other fruits and most of the common vegetables.

The low-lying country bordering the Caribbean Sea and along those rivers which flow into it, is the natural habitat of the banana, and it is this land—which was largely primeval jungle—that is now being made to yield its share of the world's food supply.

The first and most important step in the establishment of a banana plantation is the selection of the land. Climate, soil, rainfall, drainage, liability of damage by flood and hurricane, as well as by insect and animal pests, must all be considered. Then there is the problem of establishing and maintaining adequate transportation facilities.

For the plantations, virgin land is used. Usually this land is heavily forested and covered with a dense tropical undergrowth as well. Once the necessary drainage system is completed, the land must be underbrushed, lined and staked before it is ready for planting.

Each Plantation a Village

"Underbrushing" consists of chopping out the heavy secondary growth with machetes, so that the workers may move about easily between the trees. The lining and staking operation consists of plotting out the desired locations for the individual plants and marking each location with a small stick of bamboo or wild cane as a guide for the men who do the planting.

The small "marker" is usually a piece of rhizome or bulbroot, planted in the same way that flower bulbs are planted in a northern garden. The seed bulbs—each of which weighs several pounds—are dug on adjacent banana plantations and carried to the new development on the backs of pack animals.

Next comes the felling of the larger trees, which, to prevent injury to the young plants, must be done before they appear above ground. Owing to the density of tropical growth and the enormous size of many of the trees, this process is both laborious and costly.

To the uninitiated, a newly established banana plantation, after the felling has been done, would seem a land laid waste by some devastating force rather than a "farm" in the making, for the entire plantation is an almost impassable tangle of stumps and trees with branches interlocked and matted with vines, like a heavy forest shorn off at the ground and laid flat in a tangled mass.

Through this mass must be cut the right of way for small narrow-gage tramways and roads. Without this transportation system, the materials necessary for construction work and the supplies for employees and laborers could not be brought from the supply base which may be, and frequently is, many miles away, nor could the bananas themselves ever reach their waiting markets. Quarters for employees and laborers have to be built, areas cleaned and pastures made for work animals. In short, a small, complete, modern village must be built and maintained on each plantation.

A PERFECT BUNCH OF BANANAS
The banana grows with the individual fruit pointing upward and not downward as they are hung in the fruiterer's shop

Much of this work must be done simultaneously with or immediately after the planting in order to be ready to handle the crop which begins to come in twelve months later.

It is a race against time—a race in which the uncertainty of the elements plays an important part. Both farm and construction work are continually interrupted by heavy rainfall. The most promising outlook may be turned into disaster over night by a flood and several months' time and labor lost. On the other hand, should there be a drought, many of the seed bulbs may not germinate, necessitating later replanting. Also, a fire may start among the felled timber. Either occurrence is disastrous to the planting.

At the end of three months, the plantation is given its first cleaning by hacking away the branches of the felled timber and chopping down the rank tropical growth which has sprung up since the seeds were set and which, if left, would soon choke out the young banana plants.

Regularly thereafter, at intervals of three or four months, this cleaning is repeated and each time "misses," which have resulted from failure of the seed bulb to germinate or from damage to young plants by felling or other causes, have to be replaced by replanting. The success of the plantation, however, depends largely upon the "stand" of healthy plants obtained from the original planting.

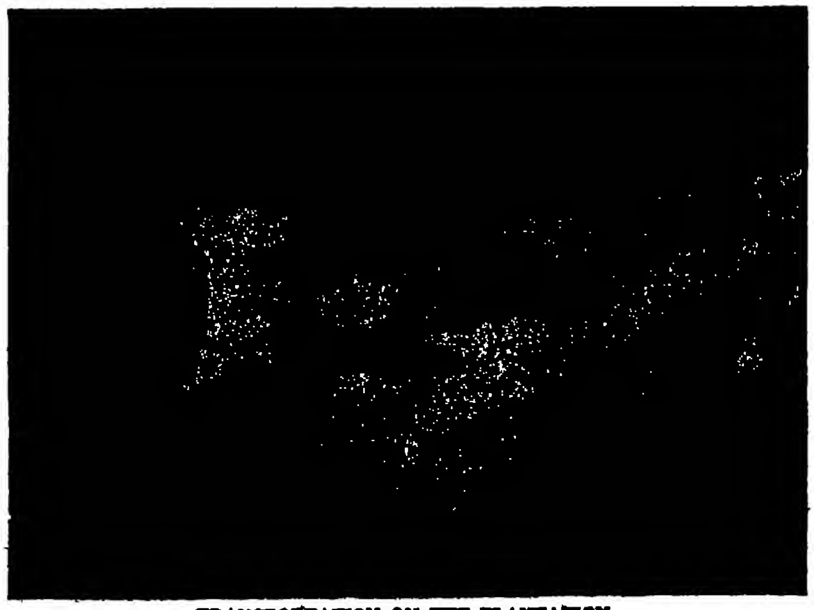
Each plantation is in constant touch by telephone with its district headquarters and the central office, which issues cutting orders to insure the fruit reaching port at the same time as does the steamer which is to carry it to market.

No Slack Times Here

The northern farmer generally ships by truck to the nearest railroad. Frequently his truck delivers his produce direct to the market. Beyond paying his share of the road tax, he is not concerned with "maintenance of way." In the tropics, however, each "farmer" is responsible for the maintenance of a fairly complicated transportation system. Throughout the year, he must keep a considerable force of men at work clearing the swift growing vegetation from the rail and tram rights of way, and from the roads by which men and pack animals bring the fruit to these carriers. There are innumerable bridges over the drainage and irrigation ditches and the small creeks. These require constant attention and repair, particularly after heavy rains, when many of them are swept away by the rushing waters.

On these tropical "farms," the slack times on which northern farmers can count are practically unknown. From the time the new land is selected until the last bunch of fruit is shipped, the race against time is unceasing.

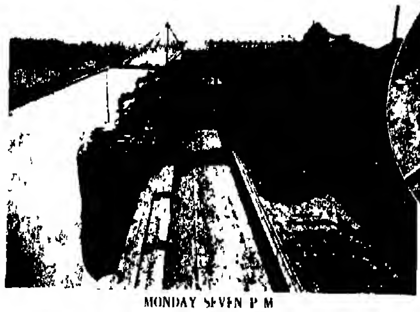
Without a doubt, the next decade will see vast development in tropical agriculture for various essentials—rubber and food products particularly. In this reclamation, the United Fruit Company stands as one of the pioneers in its accomplishments as to production and—possibly an even more important phase—the development of health and hygiene to a point comparable with that in temperate zones. It is indeed a task for the indomitable—for men who never for a moment concede that the thing they set out to do is impossible of achievement.



TRANSPORTATION ON THE PLANTATION
Bananas from distant plantations are loaded on donkeys for transportation to the railway

UNLOADING FROM THE SHIP'S HOLD
Each pocket of a moving endless belt carries a single bunch of bananas to its destination

Forty-one Hours From Raw Materials to the Finished Automobile—Through Systematic Production Methods



MONDAY SEVEN P M

It is the control of primary necessities that enables Ford cars to be produced economically. Iron ore is brought to the Fordson works in the company's own ships. Here it is unloaded mechanically and the great production cycle begins, to end forty-one hours later

TUESDAY TEN FIFTY-ONE A. M.

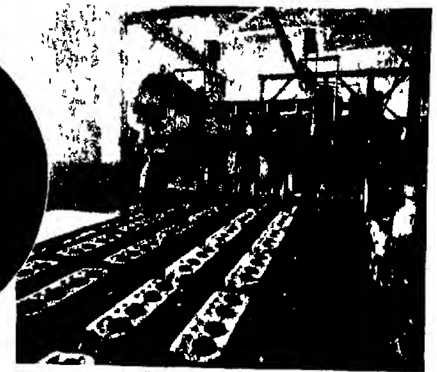
Sixteen hours later, the ore has been reduced to foundry iron. It is then cast into pigs and sent to the foundry, where it is remelted with scrap. This takes four hours in all. Blast furnace metal is also cast direct. All required castings are made in Ford factories

TUESDAY TWELVE FIFTY-FIVE P M

As the conveyor brings the molds past the pouring station, the hot metal is cast in cylinder blocks. These go to the "shake-out" station and are then taken away to be cooled and cleaned—both processes requiring several hours. These castings are then ready for the necessary machining

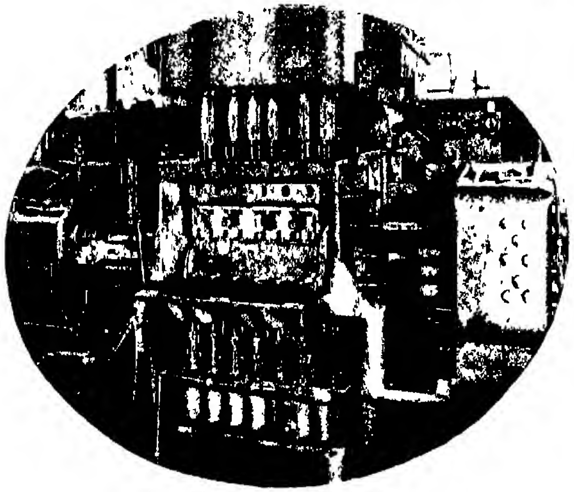
FORGING IS PROCEEDING SIMULTANEOUSLY

One hundred and sixty-two steel forgings are used in Ford cars and trucks. The Highland Park, Michigan, plant has the largest forging shop in the world. This steam hammer ram has a falling weight of five thousand pounds



TUESDAY FIVE FIVE P M

The casting now goes to its first machining operation. There are fifty-eight operations in all which are finished in approximately fifty-five minutes. All these operations are performed in the foundry building itself to save time and handling and so reduce costs

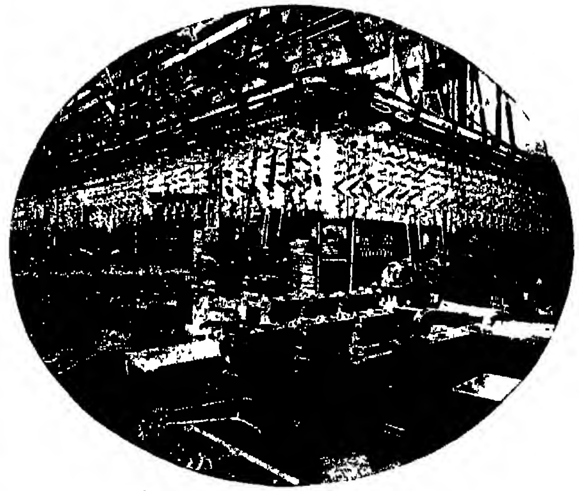


DRILLING FORTY-EIGHT HOLES SIMULTANEOUSLY

The Ford plants are equipped with special automatic machines which save vast sums every day. Here is an example, for this machine drills forty-eight holes in the cylinder block at one time. Machines which are almost human are found in all departments

WEDNESDAY TWELVE NOON—READY TO DRIVE OFF

Only forty-one hours have elapsed from the time when the ore arrived until the car is driven off. Here is the secret of Ford profits—a quick turnover made possible by an enormously efficient plant and the control of raw material. This system and the standardization of parts accounts for the low cost and popularity of the finished product

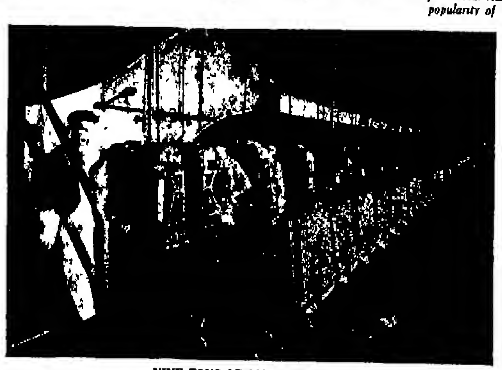


HOW THE PARTS ARE CARRIED FOR ASSEMBLY

The parts are being brought together for assembly. Mechanical conveyors are used throughout the plant. Nothing is handled by hand if it can be avoided. Special mechanics are always on hand to repair any breaks in the conveyors

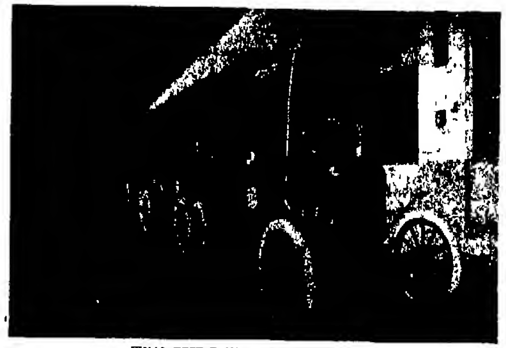
TUESDAY SIX P M

About six o'clock the motor block is ready for the assembly line. It requires about ninety-seven minutes for assembly. Nearly every operation is done "on the move"



NINE TONS OF SOLDER DAILY

Few automobile manufacturers make their own radiators, but over nine thousand a day are made at Highland Park. The illustration shows the radiators ready to be soldered



FINAL TEST TAKES CARE OF EXHAUST

Assembling of cars is done at the main plant and at various branches. The illustration shows the chassis on the assembly line, the motor exhausting into a suction chamber

WEDNESDAY EIGHT A M

The assembly lines pull the chassis a few feet and then stop, enabling the mechanics to do their bit on each car. This idea is now used in assembling other cars

FIGURE 1
On the right is shown the driving mechanism which is flexibly connected with the test piece, also the disk K with radial slot

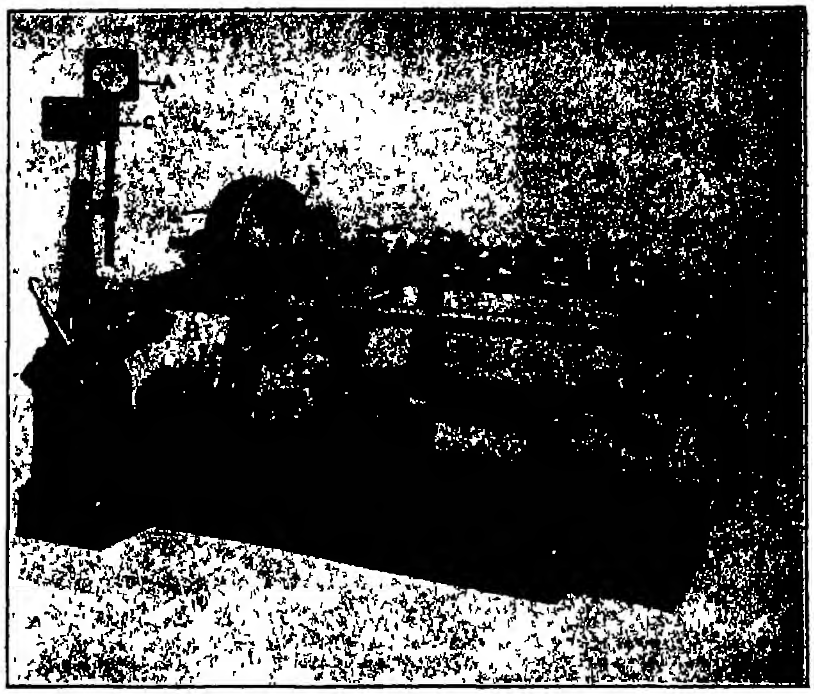


FIGURE 2
Balanced on knife edges, the test frame is free to oscillate, limited only by the control spring S and the link L at the end of the frame

Killing Vibration

An Exact, Scientific Method by which Minute Unbalanced Masses in Rotating Parts of Machinery are Being Located

IN the history of mechanical engineering, no advance in efficiency within an equal period, has been recorded, approaching that of automotive engineering during the last twenty-five years. From the single cylinder of the early days to the present straight-line eight, an astonishing record of one refinement after another is evidenced.

In his articles on Engine Balance*, Professor Cormac clearly outlined the fundamental considerations which must obtain, in order to balance the reciprocating masses of the moving parts and to eliminate vibration in high-speed, internal combustion engines. This is still an essential procedure preliminary to manufacture, but a method has now been perfected which adds the further refinement of locating the unbalanced masses in the finished product itself, both as to their total moment and their plane of location. This is accomplished by a particularly ingenious and interesting mechanism called the Gisholt precision balancing machine, which is being widely used by manufacturers for balancing crankshafts, flywheels and other rotor parts.

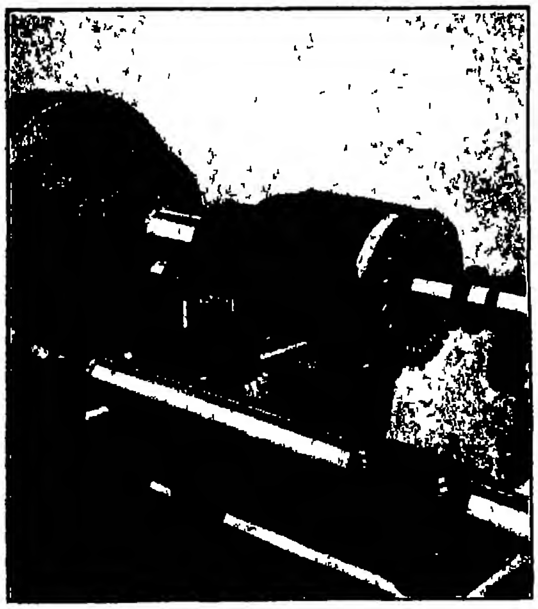


FIGURE 3
One of the important applications of precision balancing is to high speed electrical rotor parts

In a rotating shaft, a state of unbalance is caused by unequal centrifugal forces pulling from the axis in different directions. In determining the amount of metal to remove, or the weight to add in order to correct the unbalanced state, it is necessary to measure the exact amount of the unbalance in terms of some convenient unit. The unit used in the balancing machine which we are describing, is the "ounce inch." An ounce inch is the relative centrifugal force produced by a weight of one ounce at a distance of one inch from the axis.

Dynamic Balance Analyzed

Dynamic balance in a rotating object is always secured by counter-balancing in two different transverse planes, located preferably near the ends of that object. For example the drum, Figure 6, may have a heavy spot in its wall at H, the position of which is unknown. In balancing this drum, no attempt need be made to find the exact location of this heavy spot, but two planes c and d, are arbitrarily selected in which the weights C and D may be placed in order to counteract the unbalance caused by the heavy spots. Dynamic balance places the body so that when rotating at speed, it tends to lie freely in a perfectly horizontal plane, or to remain without vibration in whatever plane the center line of its bearings prescribe.

If the heavy spot H, happens to be nearer to the correction plane c, than to the correction plane d, then, in order to secure dynamic balance, the two weights C and D, must be of different sizes. The sum of the two weights, will, of course, equal the weight of H, but the heavier one must be placed in the plane c, shown in the figure. The lighter weight must be placed in the plane d, farthest from H. Such corrections would place the drum in complete static and dynamic balance.

In the illustration, Figure 2, the various important parts of a precision balancing machine are indicated. B is the pivoted frame on which are mounted the headstock E, and two adjustable roller bearings for supporting the shaft to be tested. This frame rests on two "knife-edge" pivots P, which are located a substantial distance apart in a transverse plane in order to give stability to the frame. This frame, with its pivot bearings, is flexibly held in a

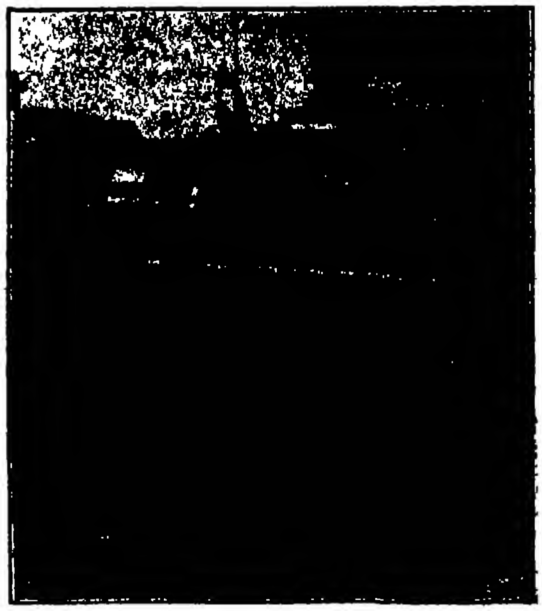


FIGURE 4
Important improvement in the efficiency of fans has been obtained by correct balance

*Scientific American, Vol. 133, Pages 33-34 and 183-184 (July and August, 1925).

horizontal position by means of the long, flat spring S, which is fastened rigidly at one end to the heavy base of the machine, the other end being attached to the outer end of the pivoted frame by means of the spring L.

The headstock E, carries a spindle which is provided with a suitable clutch for making a positive but flexible driving connection with the shaft to be tested. There is mounted the large disk K. This disk is provided with a radial slot in which slides a counterweight W, which may be clamped in any location in the slide from the center to the edge of the disk. See Figures 1 and 2. Along the slot there is a graduated scale in inches and decimal fractions thereof. This has its zero mark at the center, and bears an index mark cooperating with this scale. The standardized counterweight is 10 ounces, and by means of this, the disk K, may be thrown out of balance by any desired amount, measured in ounce-inch units.

Counterbalancing the Unbalance

When the counterweight is at the zero mark on the scale, the spindle with its clutch and disk mounted on it is in a state of perfect balance. The frame, loaded with its headstock and the piece which is about to be tested, is free to swing on the knife-edge pivots like a scale beam. Due to its weight, it has considerable inertia. This inertia is counteracted by the heavy spring S. Therefore, with the shaft and spindle at rest (not rotating) the frame, when given an impulse, will oscillate up and down with regular beats, the time of which is constant and independent of the amplitude of the swing. These beats are recorded through suitable links on the indicator A. The length of time for a complete oscillation is called the "natural period" of the frame.

When the object which is being tested rotates at a speed such that the time for one revolution exactly equals the natural period of the frame, it is said to be rotating at the "critical speed." In operating the machine, the critical speed is obtained by starting the shaft at a speed slightly too high, and then, as it continues to rotate by its inertia, letting it gradually slow down to the critical speed, at which the number of revolutions and oscillations exactly coincide.

On account of the existing unbalance above noted, its rotation will obviously cause the frame to oscillate on the pivots. By watching the pointer move on the indicator A, as the piece continues to rotate, the amplitude will be observed to increase slowly as the speed of rotation slowly decreases. When the critical speed is closely approached, the amplitude will begin to increase at a more rapid rate, and when the critical speed is reached, the amplitude will be maximum.

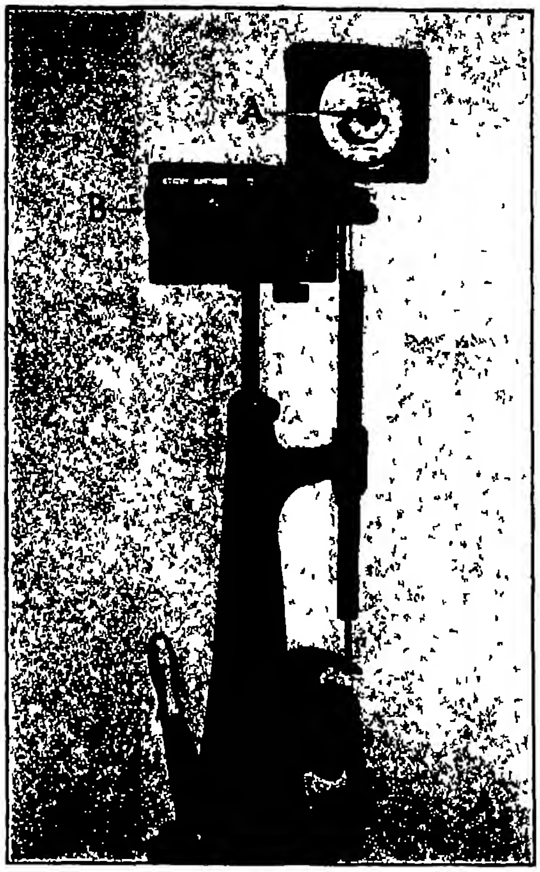


FIGURE 5
Above, "A" registers the beat or oscillation of the balanced frame—both amplitude and period

This process is based mainly on the fundamental principle that the maximum amplitude of the pivoted frame (which occurs when passing through the critical speed) is always in exact proportion to the amount of unbalance existing in the shaft being tested. This principle permits not only the measurement of the exact amount of unbalance in ounce-inch units, but also the determination of the exact angular location of the heavy side. Thus a mark may be made on the shaft or other objects being tested at the exact point where correction should be applied. As the measure of unbalance is the maximum number of scale divisions swept by the pointer, it is necessary to determine by test the value in ounce-inch units of each division. This value is called the "calibration constant."

With the counterweight set at the center, or zero position on disk K, the test piece is whirled and the amplitude reading noted on scale A. (Figure 5). This reading is the record of the free swing and the number of scale divisions covered by the pointer is the measure of the existing unbalance. The counterweight now is set at a sufficient distance from the center to create an arbitrary amount of unbalance in the disk K. A few trials will find the position at which the amplitude reading is greatest. In this position, the known unbalance in the disk, and the unknown unbalance in the test piece are acting in the same radial direction, and this amplitude reading is, therefore, the measure of the sum of the two amounts of unbalance. Because the unbalance of the disk is a known quantity, it is a very simple matter to determine the required calibration constant.

For example, suppose the unbalance existing in the correction plane of the shaft which is being tested is known to be 15 ounce inches, and that in testing, the maximum sweep of the pointer is observed to be 12 scale divisions then the value of each division will be 15/12 or 1.25 ounce inches. The calibration constant is, therefore, 1.25.

With this correction arbitrarily applied, the machine is again speeded up and allowed to pass through the critical speed, as before. The second amplitude in this process bears a relation to the first amplitude which is dependent on the angle between the point of application and the point required. After determining and setting off this angle, a third run will check the result. For determining the corrections proportionate to amplitudes, and for ascertaining angles, the special calculating rule C, which requires but two settings, is furnished. This rule is also mounted on the instrument column at the left.

The Exact Point of Correction

After completing the first determination, the work is reversed in position and the correction is determined for the plane initially over the pivots, thus completing the operation. A critical speed of about 100 to 110 revolutions per minute is generally employed. This low speed prevents distortion of the work due to centrifugal forces.

In the precision balancing machine, we therefore have a means of measuring directly and exactly the amount and location of the correction necessary to furnish exact balance. This is a big practical step toward the complete elimination of the evil of vibration in modern high speed machinery.

That the silkworm is being replaced by a chemical process is now an established fact. An authority on chemistry will, in our August issue, outline the way in which this is accomplished

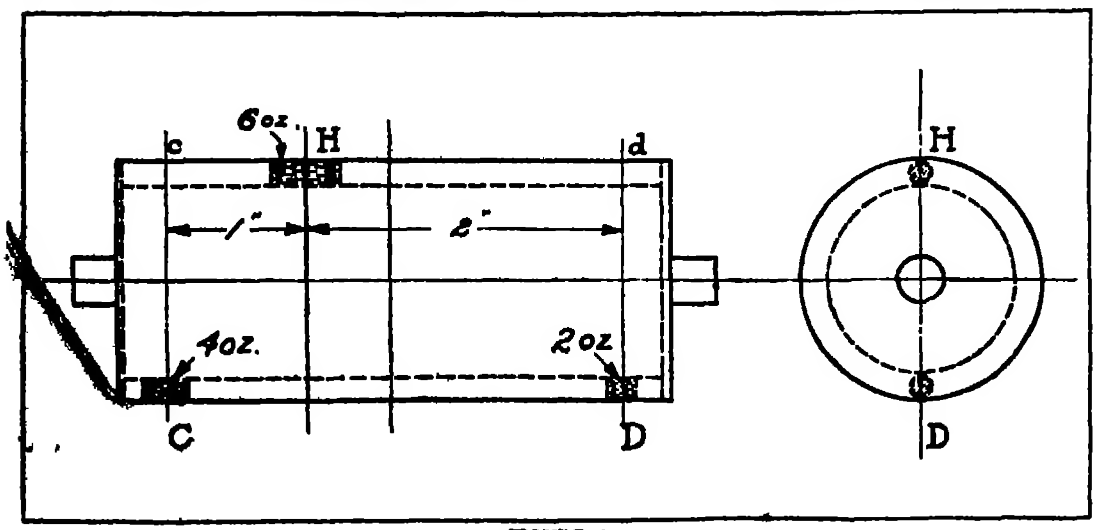


FIGURE 6
A diagrammatic representation of the method of overcoming static and dynamic unbalance H, by two counterbalances C and D placed at distances which are in proportion to their weights

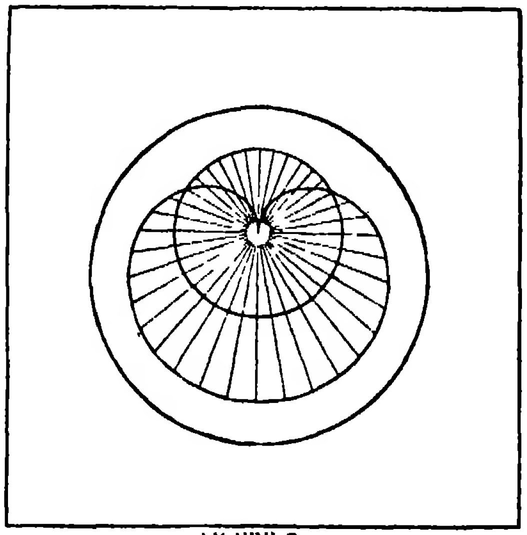


FIGURE 7
Based on this Chart of Angles, Newkirk's Law is developed and applied

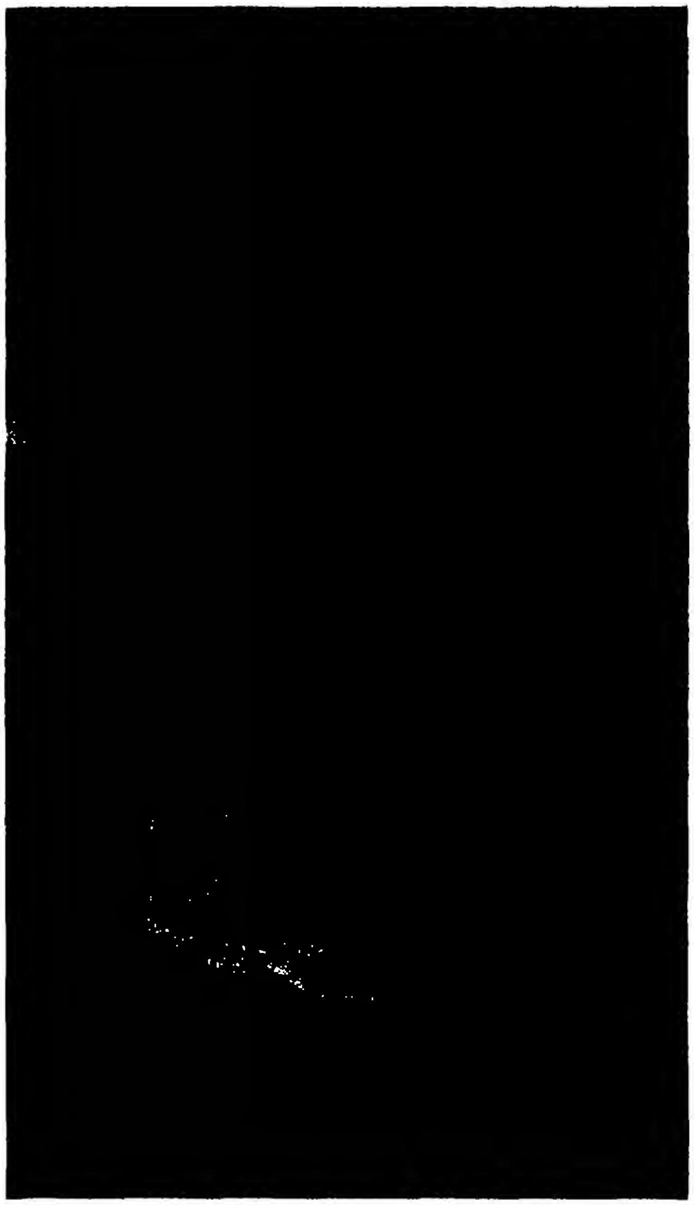
What Will the Next Ten Years Reveal in Yucatan?

Never before has the world devoted so much attention to the extinct civilization of the Maya Indians. Long ago a few archaeologists discovered some of the ruined cities of this once great people, yet it has taken decades for science to realize the extent and number of these ruins, and their significance. Moreover, only in comparatively recent times has the necessary money for their excavation been available. Today, work is proceeding as never before. The last excavating season saw at least three important expeditions in the field. The Mason-Spinden expedition explored an important area along the eastern coast of the Yucatan Peninsula. Dr. Thomas Gann, noted English archaeologist, worked in Yucatan, in connection with the British Museum. The Carnegie Institution has worked during two years under the able leadership of Dr. S. G. Morley, and plans have been made for the continuation of this work for another eight years. Important results should follow.

Only comparatively few of the ancient, ruined cities of the Mayas have yet been excavated. Many others have been discovered but given only preliminary attention. How many more lie buried beneath debris and concealed by the sub-tropical forests no one knows. But it is not unlikely that the coming decade will reveal many of the remaining secrets of the Mayas—perhaps even that of their inscriptions.

REASSEMBLING FALLEN RUINS OF MAYAN ARCHITECTURE

Very little is known about the Mayan hieroglyphs The signs which have enabled archaeologists to work out important Mayan dates are now known, as are the symbols for the gods, the sun moon and planets It is not believed, however that any of the inscriptions are purely literary, as are those found in Egypt, Mesopotamia and other parts of the Old World



AN ARCHWAY IN THE GOVERNOR'S PALACE AT UXMAL

This building, 320 feet long by 40 feet wide, contains two of these archways The Mayan arch was simply a facing over a concrete filling They did not understand the principle of the true arch with keystone, and their arch was therefore not as strong as such an arch would be

All Photographs by Kadel & Herbert

EASTERN SIDE OF THE NUNNERY QUADRANGLE AT UXMAL, WITH THE HOUSE OF THE MAGICIAN SURMOUNTING A PYRAMID IN THE BACKGROUND

At Uxmal there are five large groups of buildings, the Governor's Palace, the House of the Turtles, the House of the Pigeons, the Temple of the Magician and the Nunnery Quadrangle. In this picture the Temple of the Magician is shown on top of a pyramid 80 feet high, and 240 by 180 feet at the base

Novel Devices for the Shop and the Home

A Department Devoted to Recently Invented Mechanical and Household Appliances

Conducted by Albert A. Hopkins

The works are contained in the dial

Hydraulic timing device for racing cars depends on the incompressible water in the hose

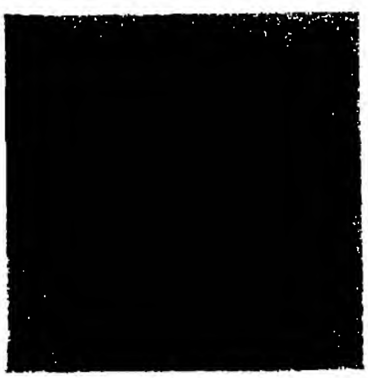
A quartz and gallium high temperature thermometer

A New Type of Clock

ONE of our English correspondents, Mr. R. N Pickering, a well-known clock designer and manufacturer of London, has favored us with photographs of a most interesting clock and a beautifully engraved dial Mr. Pickering has discovered alloys which render steel parts and oil lubrication unnecessary The movement is supported on a heavy back plate which is bolted to the case and which carries two massive pillars for supporting the frame The frame, in turn, carries the time train and the twelve-inch dial The frame is made of a circular ornamental plate and a front bar, placed one inch apart, thus allowing space for the barrel and other parts of the mechanism The dial is silvered and the raised figures are of gilt. A smaller dial of similar construction shows the seconds. All the parts are richly gilded, pierced and engraved The beauty of similar workmanship will be seen in our smaller engraving The pendulum consists of a glass jar of mercury suspended in an ornamental stirrup.

An Accurate Method of Timing

AN inventor, of Anderson, Indiana, has devised an interesting hydraulic timing device for racing cars. The hose, as shown in the engraving, is an ordinary three-quarter inch garden hose. When the driver is qualifying on the track, the front wheels force the water into the cylinder barrel which operates the lever. The lever, in turn, starts the stop-watch. After the lever or plunger is moved outward, the rear wheels have no effect on the hose, because after the car is on its qualifying lap, the plunger is pushed back to its normal position. As the driver crosses the hose again, it stops the watch.



Pierced dial for the regular clock

First Aid to the Picnic

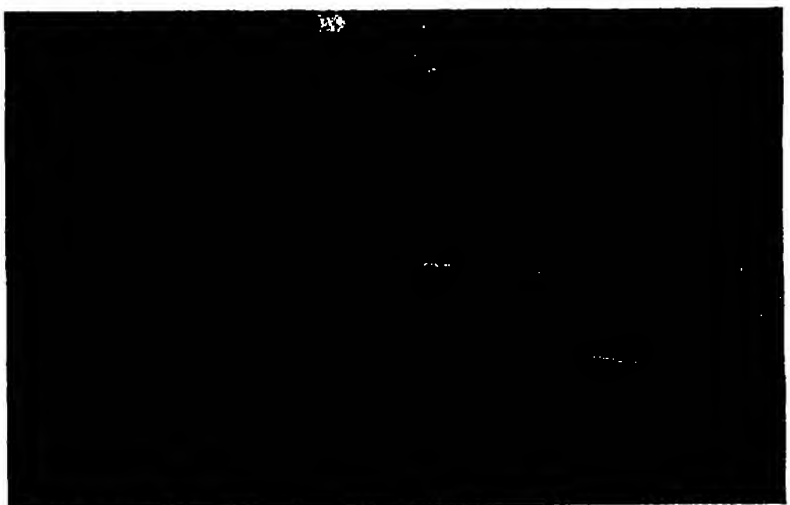
NO longer need a picnicking party laboriously hunt a clean, level, grassy spot on which to spread a cloth for lunching. The trunk that rides in style on the back of the automobile and carries all the supplies may be turned into two fair-sized tables and two stout benches on which the lunchers may sit. We illustrate a closed trunk and also one opened, to show the character of the furniture when in use. The sides, as will be noted, form the tables, and the double ends, the two benches. All are put together in a jiffy.

Anti-Pilfering Lockers

WE constantly read of students losing their clothing, et cetera, while attending classes. To obviate these losses from petty thieving, a plan is in use by which space behind movable blackboards in the classroom is utilized for lockers. The black boards may be raised and lowered so as to give an opportunity for hanging up the clothes. When the blackboards are pulled down, the racks with the students' clothing are not visible

The lower part of the sliding blackboard is of wood.

A crook-proof cloak room



When an auto trunk is not a trunk

A New Scientific Thermometer

THE writer recently visited the wonderful laboratory of the General Electric Company at Schenectady and was shown a thermometer which, from all appearances, looked like the usual mercury-in-glass thermometer Upon looking at the graduations, he discovered that a temperature of eighteen hundred degrees could be registered The bulb and stem is made of fused quartz, and instead of mercury, which would boil and cause the thermometer to explode at such a temperature, gallium, one of the rare metals, is used A temperature of one thousand degrees Fahrenheit is the maximum with the mercury in glass thermometer, and such thermometers are inaccurate at high temperatures Thus is one of the first developments in the practical use of quartz tubing. Gallium is similar to mercury in appearance, but is much lighter in weight. It melts at a temperature of one hundred degrees Fahrenheit and can be cooled to about forty degrees before solidifying Gallium boils at about thirty-six hundred degrees, so it is not necessary to have it under pressure in the thermometer

A Toothbrush That Is Different

AN Illinois concern has put out a toothbrush that is quite different from any thing on the market It is round and made of stiff bristles which can penetrate between the teeth, thus covering spaces which are not touched by the ordinary toothbrush

A toothbrush that rotates

Using the scraper to clean pots and pans

Combination Brush-and-Scraper Has Many Uses in the Kitchen

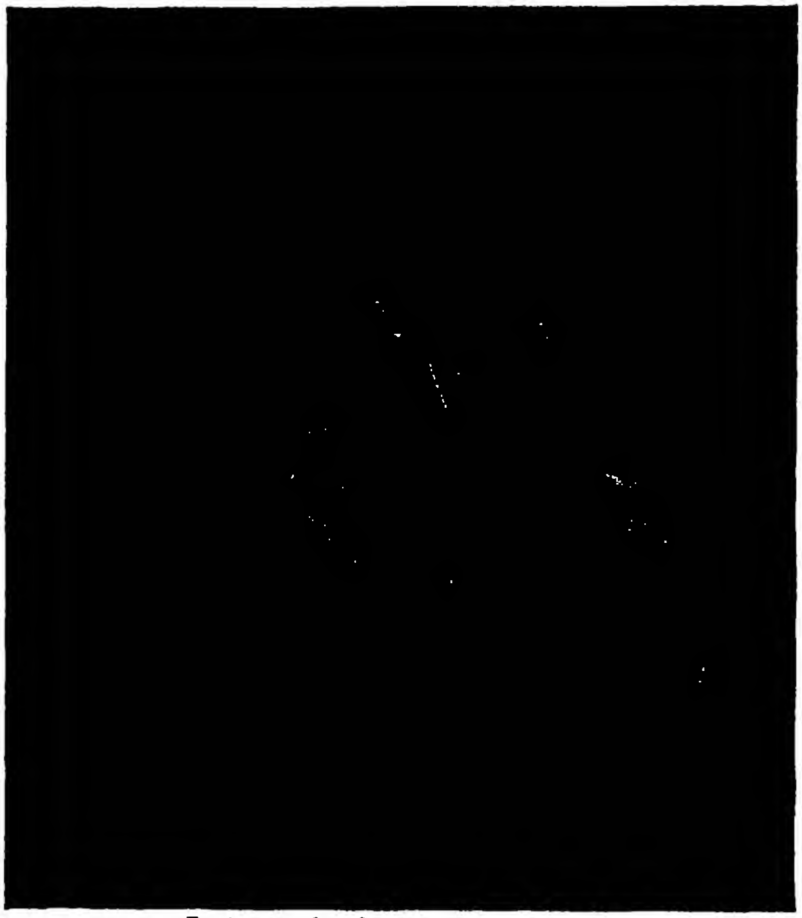
THIS combination brush-and-scraper has many uses in the kitchen in cleansing pans, dishes, or even scraping and brushing vegetables for cooking. Sticky food on the stew pans and fry pans may be easily scraped off with the scraper which is rigidly fastened to the edge of the brush. The brush is useful when using soap and water in cleansing particularly dirty pans. Potatoes and other vegetables which are usually quite dirty before cooking may be quickly cleaned with its aid. Since the device is usually sold for a dime, it would pay to have two, one for each purpose.

A Sensible Toy for Children

THERE has recently been introduced a new toy consisting of tin sections from which miniature buildings can be easily constructed by children. Sets composed of floor pieces, walls, windows, et cetera, may be

A spoon with a graduated bowl

had in varying sizes. The enameled floor pieces are made to receive a binding plate so that they may be attached to other floor pieces. Any style and size of building may be constructed with the binding plate as a basis. After the floor pieces have been joined together in the desired shape, the youthful contractor can fit the edges of the walls and windows into the grooves of the floor pieces. In case the building is going to be more than four squares each way, it can be braced by placing supporting walls between every second floor. The pieces may be had in various colors. The walls, floors and windows are made uniform in size



Putting together the tin sectional toy house

There are several types of windows, doors, cornices and balconies. If the boy's pocket-book is deep enough he can construct a replica of the Woolworth Building or any other tall structure. The units are small and are not easily broken.

Interesting Method Used in Photographing Animals

THE art of focusing a camera on a group of pigs and securing good pictures has annoyed a great many photographers. A

This animal group was posed by a new method

Scraper is attached to the edge of the brush

method evolved by the workers at the Ohio State Agricultural Experiment Station should be of value. A frame of galvanized partitions furnishing eight stalls in a row is the principal part of the apparatus used. A wire screen is used in the front of the stall while a galvanized iron gate is placed in the rear of each stall. With the frame in place the pigs are driven separately into the stalls so as to face the camera through the wire screen. The camera rests on a tripod at a certain distance in front and is focused on the pigs through the screen. As soon as the camera is properly focused, which may be done at the operator's leisure, the frame is

A magazine toothbrush

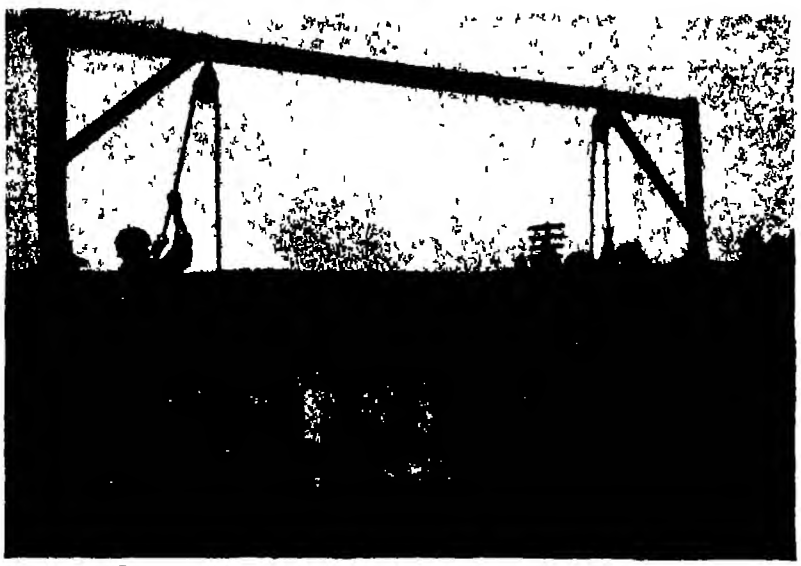
hoisted by means of overhead pulleys and exposures are made as soon as the frame is clear. This method does away with the annoyance of trying to get a number of obstreperous pigs to look their best.

Measure as You Mix

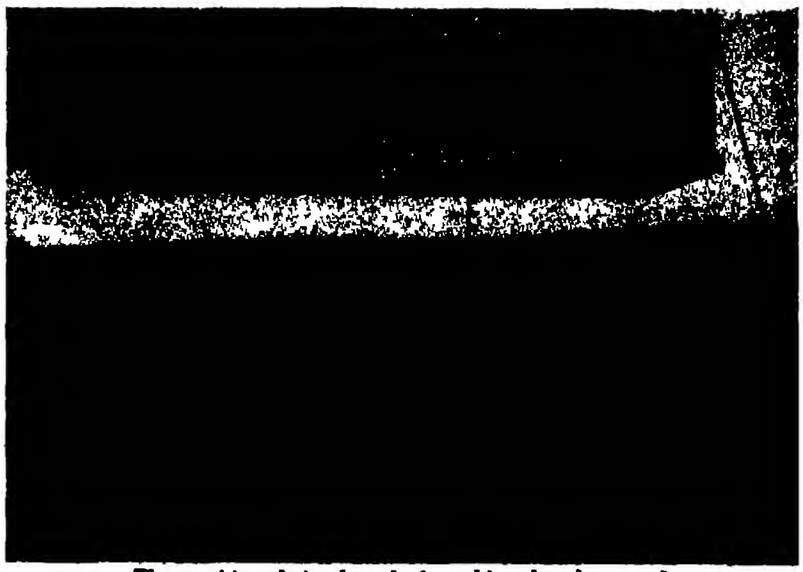
IN this kitchen spoon, the bowl is graduated so that solids or liquids can be measured. There is a pouring lip on the side of the spoon.

The Toothpaste Is Not Forgotten

IN this toothbrush, the paste is carried in the handle, and pressure on the tube feeds the paste to the bristles. Any standard tube fits the handle and the brushes themselves can be renewed. A cover slips over the bristles and a valve locks the supply of toothpaste when you travel.



Getting ready to lift the partitions with the animals inside



The partitions hoisted ready for taking the photograph

An educational toy for children

A Wooden Library

THE "wooden library" is composed of blocks, which are hinged, as shown in the upper engraving. They may be folded together like a book. All sides of the "book" except the back are covered with entertaining pictures which vary to suit the taste of children of all ages. The blocks are almost indestructible, and they may be made into numerous combinations. Towers, bridges, lighthouses, bungalows, water wheels, arches, arbors, forts, houseboats, battleships and airplanes are among the many things which may be built with these blocks.

An Austrian car seal of novel design

The New Letter Boxes

ONE of the disadvantages of apartment-house dwelling is the inability of the ordinary mail boxes to hold magazines. Of course, where there is hall service there is no difficulty in securing second class mail, but many thousands of apartment houses are now being built on the "walk up" plan with the result that there is no hall service. The magazine problem remained unsolved until a couple of years ago when the Post Office Department permitted a new type of delivery box to be installed which is sufficiently large that magazines may be inserted in tenants' boxes. There are several styles of such boxes on the market; and we show one which has been approved by the Post Office Department. The idea is to have the upper portion of the box opened up by the postman who puts in magazines or other articles. The tenants can open the box with their regular keys. Each individual box is eighteen inches high, four and one-half inches wide, and four inches deep, and is thus of ample size to accommodate the largest magazine published.

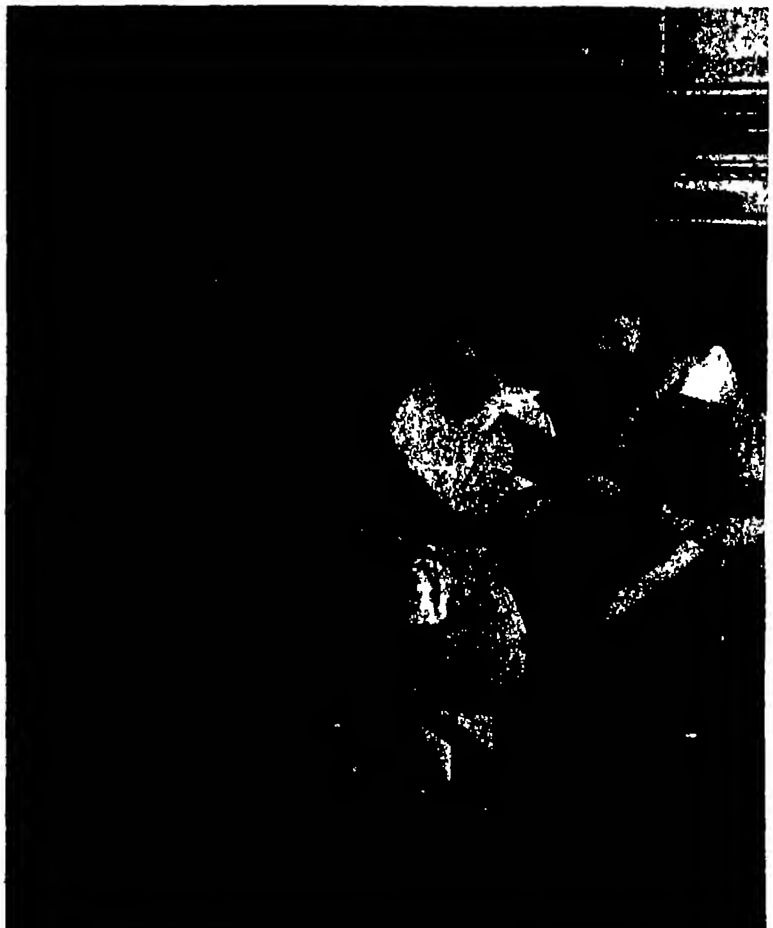
The boxes are designed for flush mounting. The body is constructed of cold rolled steel, finished with rustless black enamel. The fronts are of heavy die-cut brass, standard brush brass set in ebony finish frames. The upper, or master door is made in one piece and extends the entire length of the unit. The door, nine inches high, provides ample room for the deposit of all mail matter. This door is secured by a Government lock, furnished and installed by the local postmaster, on demand, free of charge. The lower or individual doors are also nine inches high, enabling the tenant to readily remove his mail. Each box is furnished with individual lock and keys and name-card holders, and each box is a steel safe in the wall of the building.

Tool for placing chains on auto tires

This new type of mail box accommodates long magazines

A Comfortable Hair Cut for the Child

THE device shown converts the adults' barber chair into a comfortable chair for children. In our large cities we have in department stores barber shops for children only. The chair for the child is carried normally at the side of the adults' chair, and it is swung into place in an instant when the youthful customer enters the shop. Children have a dislike for the barber shop because, perched upon a slippery seat without support, they soon tire, but this arrangement will help to make them happy.



Reading the bookie blox—a combination toy and book

A child's chair for the barber's use

A Radio Clock

A BROOKLYN inventor has devised a dial for a clock which will help DX fans to time their far-away stations. The dial carries the names of the units of standard time, such as "central," "mountain," "Pacific," et cetera. The dial can be applied to any clock.

A Useful Tool for Putting on Chains

SERVING as an extra hand, even substituting for the fingers, a recently invented tool for placing chains on auto tires is designed to save time and labor. It makes the

A clock for DX fans

job easier and more secure, and it eliminates the unpleasant task that was faced when chains were put on only by hand. It is a metal bar having a second bar attached close to one end, and it is applied to the chain to pull it to proper tension without effort.

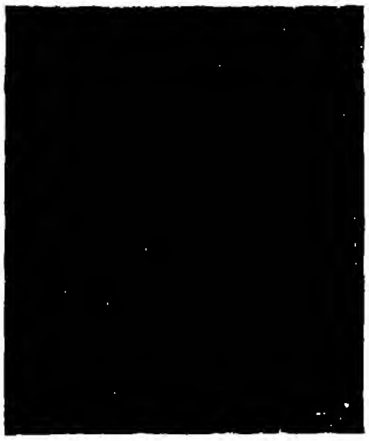
A Car Seal That Has Been Adopted by the Austrian Government

THE combination lock-car-seal shown on this page may be used on post office trucks or mail bags. In Austria, the freight cars are sealed and the combination is sent on by railway mail. The post office trucks have a fixed code for every day which is changed in different localities.

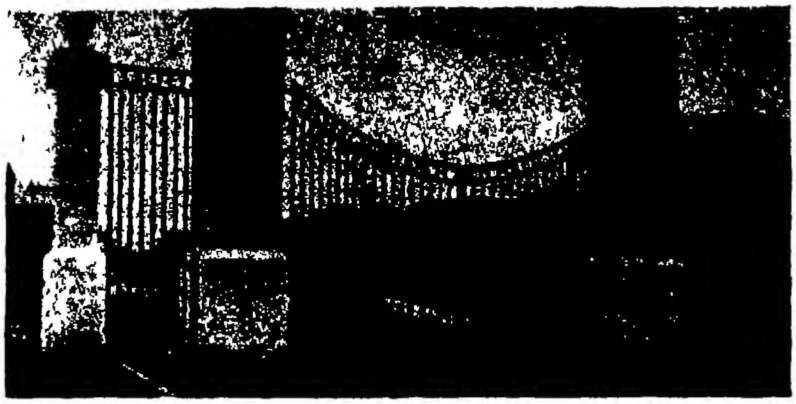
A Chemical Windshield Wiper

A NEW windshield wiper is made in the shape of a handy mitten. One rub is good for a number of hours. It is a chemically prepared felt mitt that fits the hand, impregnated with a harmless odorless chemical. It can be applied to automobile windshields, street cars, locomotives, and even store windows.

A wiper for automobile wind shields



A fence with all joints welded



This ornamental gateway was made from oxy-acetylene welded pipe

Fences from Scrap

ONE large plant recently had need of a strong, yet not ungainly fence, with an impressive gateway. They had an ingenious employee who saw the connection between a nearby junk pile, an oxy-acetylene blowpipe and the company's need. The first step consisted of providing pipe of correct diameter from the junk pile and then cutting it to proper length. This was readily done with the cutting blowpipe. It proved a simple matter to weld short pieces together. When a good supply of usable lengths was on hand, assembling began. Heavy wire netting was used for fence covering between posts. The apparent difficulty of attaching the wire to the posts was easily overcome by using the cutting blowpipe, U-shaped cuts were made in each post and the tongue formed was bent inward over strands of heavy wire. The method insures strength and durability. The attractive gateway shown was made in the same manner. As the gateway was to be more ornate, a little more time and thought were spent in its construction. Our engraving shows the very artistic results attained. Carefully graded lengths of pipe were welded to a straight supporting cross-beam of heavier pipe, two bent pipe lengths rounded off the top of each large gate. These graceful bends were made after heating the pipe with an oxy-acetylene flame. Then cross sections of large diameter pipe were cut with the blowpipe, and were welded at intervals along the top of the gates.

A new type of dough mixer

Prevents doors slamming

Breaking This Pencil Point Sharpens It

IN this pencil all of the points come ready made for you in a single strip of filler. Break off one point and another is ready to take its place. The "filler" is held in place by a thin piece of metal which makes breaking very easy. A pencil of this kind is a great help to the busy man.

Taking the "cars" out of the apartment house garage in New York

A Wire Dough Mixer

AN extremely rapid device for use in the making of pies and biscuits is illustrated. Its shape keeps a permanent tension on its ten cutting wires, and these spring aluminum knives keep cool during mixing.

Door Check Keeps Key in Lock Also

THIS invention answers two purposes. First, it prevents doors from slamming and makes possible ventilation through the door at any angle. Second, the same device can be used to run through the hole in a door key to keep prowlers from pushing the key out and picking the lock.

Fatigueless Inspection

THOSE who have occasion to visit large plants know the great fatigue which is experienced after a day's tour. To obviate this condition, a Chicago concern has devised a small truck, provided with seats, for inspection by executives, works managers or visitors. This trailer can be attached directly to a tractor or to a tractor-train as shown.

A Baby Carriage Garage

NEW YORK is in great need of modern housing, and it is hoped that soon the greater part of the slums will be redeemed by the introduction of modern tenements giving plenty of light and air. In one of the houses of the Hudson Guild, accommodating 45 families, a garage for baby carriages has just been installed. Each of the families living in the house contribute five cents a week, whether they have children or not, for its upkeep.

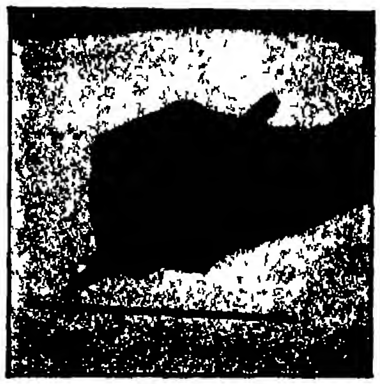
Shop inspection trailer saves excessive fatigue

Adjusting the gasoline supply

Automatic Gasoline Control

WITH this device, when the motor is cool, more gas is admitted, but when the motor has warmed up less gas is needed and the amount of gas admitted is reduced. A coil of thermostatic metal is so placed that when the motor warms up, it expands, turning a rod, one end of which is attached to the control lever of the needle valve. This operation cuts down the amount of gas supplying the carburetor. When the motor is cold, contraction reverses the process.

A wrist score card



A pencil that is always sharp

Combination lock for automobiles

Combination Lock for Automobiles

THE object of this device is to provide an automobile lock which may be attached to the steering post without interfering with the manipulation of the steering gear by an authorized person who knows the combination of the lock. The casing of the lock supports a locking bolt which controls the movement of the steering post so that when the bolt is advanced the steering post cannot be turned. The movement of the locking bolt is controlled by tumblers, as in a combination lock. When the tumblers are properly positioned, radial slots will register so as to allow of the passage of the head of the locking bolt. There is an indicating dial on the outside of the case.

Testing a New Moving Sidewalk

PARIS has always been to the fore where transportation is considered. The French metropolis is so vast and the traffic is so

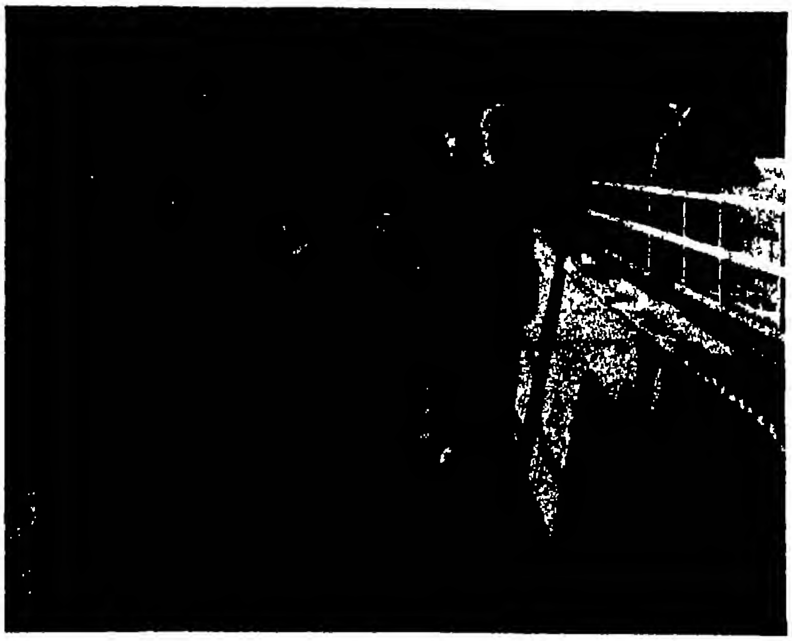
A funnel for many uses

congested that anything which will tend to do away with moving vehicles is certain of a test. A new type of moving stairway was recently tried out at Bellevue, a few miles from Paris. The upper illustration shows a practical test of the device, and the lower engraving shows how the hand rail is operated in comparatively short sections. If the rail was in very long sections, the friction would be very considerable.

Collapsible Automobile Seat

AT the recent Olympia Motor Show in London, one of the novelties was an air-cushioned seat which is collapsible in every detail, even to the supporting stand and feet. The construction is plainly shown in the engraving.

Taking the warp out of the large ice-chest



Testing a new moving sidewalk in Paris

Keeping Refrigerator Doors Tight

TO prevent warping of refrigerator doors, a door truss has recently been invented by a Chicago man. This truss is formed of two steel rods. It may be used on new doors or it may be applied to doors already in use. It keeps doors straight by pressing the warped parts tightly into alignment. By turning a part of the truss at the center, where the rods meet, the rods may be tightened by shortening or increased in length when the door expands.

Movies in Daylight

A NOVEL moving picture machine toy, which has recently made its appearance in this country from abroad, can be used in daylight. The pictures are viewed through an aperture equipped with a magnifying lens. The film is moved by a crank at the side, and each individual picture, or pose, is automatically held stationary for a fraction of a second between this lens and an opening immediately at the rear.

Mechanism of the moving sidewalk

Movies in miniature in daylight

An extra seat for the car

A Funnel That Mixes, Measures, Pours

A NEW funnel fits all standard screw top fruit jars, ranging in size from one-half pint to one half gallon. Screwed on the top of any single jar, it converts the jar into a bottle which pours easily. The funnel is also a measuring cup.

A soap tablet

Kind to Greasy Hands

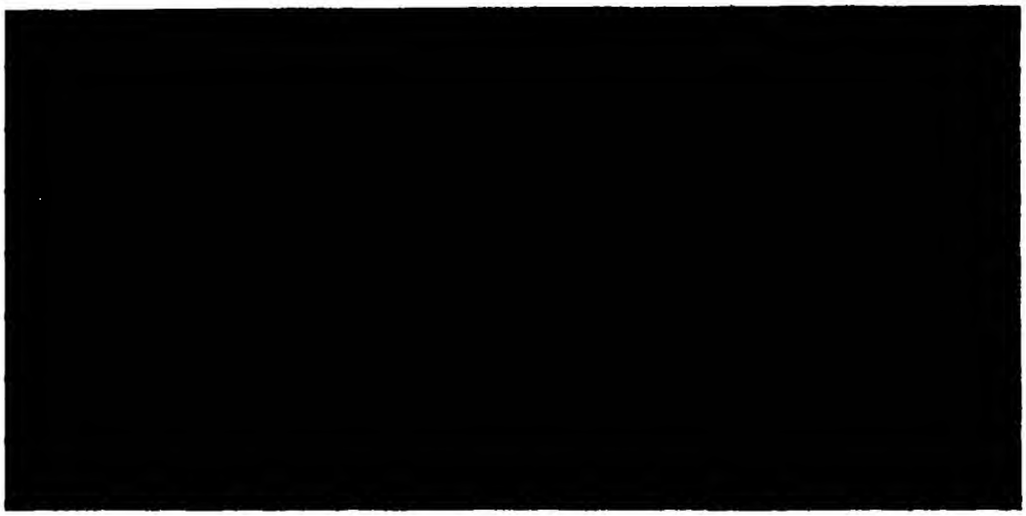
THERE is on the market a handy soap tablet which removes grease, leaving the hands soft. It is a composition of soap and sawdust with glycerine. When a small amount of water is poured into the palm of the hand on the tablet, the tablet swells, absorbing the water.

An Envelope Sealer Without Moving Parts

IN this device the envelope is closed by merely passing it through the sealer by a single operation of the hand as shown in the illustration. The idea of a small sealer without motors or moving parts is that every department of an organization can have one.

A simple, individual envelope sealer

Branding Timber by Machinery



FRESH FROM THE BRANDING MACHINE
Branded lumber showing the cypress and mill marks that serve as identification

Ends of Lumber Branded

Even as sheep are branded, so is lumber. Producers of cypress lumber in particular have found it advantageous to brand each piece with marks which will indicate at once that it is cypress, and will also designate from which lumber mill it comes. To this end, the lumber is carried by endless conveyors past a revolving metal drum, the entire face of which is embossed with the necessary patterns for the branding. As each plank or board passes the drum, it halts momentarily and is held in place by a shoe located beneath it. The drum stamps its impressions on the end of each piece, which then passes on to the yards to be piled with its neighbors and held ready for shipment as required.

THE ENDLESS CHAIN
Looking toward the branding machine. Note the lighting equipment for night work

TOPPLING TOWERS
Here are piles of lumber which have been branded and are ready for stacking

READY TO BE BRANDED
The boards to be stamped are brought up in trucks to the endless chain, to which they are transferred. Then they are carried down to the branding machine

The Scientific American Digest

Newest Developments in Science, Industry and Engineering

Conducted by Albert G. Ingalls

A Marvel of Modern Reconstructive Surgery

How a skillful and sympathetic surgeon provided an armless boy with two movable and useful arms made from the boy's own body is the remarkable feat described in a recent issue of the *Journal of the American Medical Association* (Chicago)

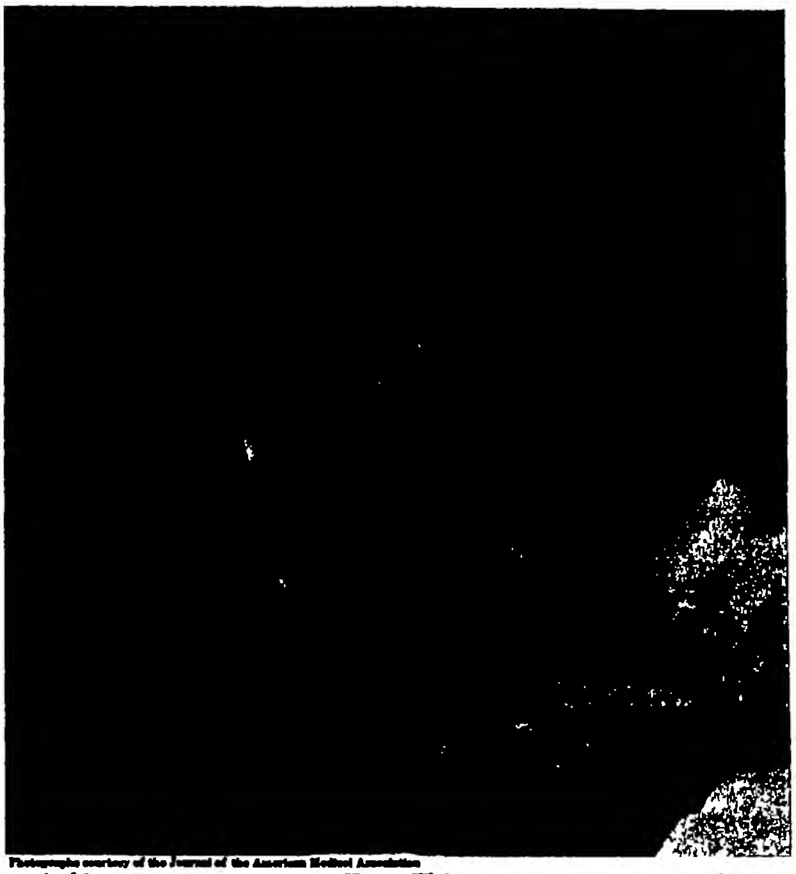
By X-ray examination, it was seen that this boy's absolutely armless shoulders concealed a small, under-developed fragment of the humerus three inches long on the right side and about four inches long on the left. An operation freed these rudimentary bones, muscle was obtained from the chest and built on them, and the boy was then carefully trained to employ these muscles. He is now able to perform complicated tasks and even to operate a typewriter

The boy's name, stated in the source quoted, is Henry Wiegman. (The writer of the present abstract has previously obtained his sanction to present a brief account of the remarkable surgery by which he was provided with a pair of arms—Henry believes, in fact, that "it may do some other fellow some good")

The operation was performed in 1920, but the surgeon, Dr. Harry E. Mock, of Chicago, purposely waited a few years to see the results before publishing his report Henry, at the age of twelve, was an unusually bright boy, says Dr. Mock. He was up with his class and showed a marked talent for drawing. Under the patient care of his mother and sister, he had learned at two to scoot, at four to walk, while at six he could hold a pencil between his cheek and shoulder and make lines. At seven, he could thus write and draw He opened doors by grasping the knob between his cheek and shoulder, while the little wooden Santas sawed out by a scroll-saw held in his toes became famous. At eight he became expert on the typewriter, but could operate it only by striking the keys with a long stick held between the cheek and right shoulder

At twelve, Henry began to want arms and sleeves, and his case was then studied for the first time from the point of view of reconstructive surgery The examination showed two small elevations of the chest wall at the poorly formed shoulders. On both sides, there was a fairly developed posterior portion of the deltoid muscle, the muscle that caps the shoulder Two short fragments of the bone of the upper arm were found by X rays, as mentioned above.

The surgeon states that at the time these examinations were made by himself and several members of St Luke's Hospital, "none of us ever dreamed of the development in these rudimentary humeri that had occurred." In June, 1920, he operated on the right side, making two four inch incisions and dissecting out a flap of skin which was to cover the under surface of the stump after the rudimentary bone was freed.



Photographs courtesy of the Journal of the American Medical Association

At his present age, seventeen, Henry Weigman can operate a typewriter efficiently. He was born without arms but skillful surgery provided him with arms of flesh and bone

The bone, about the diameter of that of a two-year-old child, was carefully freed so that it could be pulled out at an angle of 30 degrees. There was now presented a small, rudimentary humerus three inches long, covered with the muscle mentioned. To this was attached the *pectoralis major* muscle from the chest. A skin flap from the chest wall was wrapped around it. Two weeks later, the left side was similarly operated on. Neither of the wounds became infected and the patient made an excellent recovery.

The boy now had two small stumps, but lacked the ability to move them in any direction. So, in two months, Henry went to the Spaulding School for Handicapped Children, where Miss Jane Neil, the principal, and Miss Carney, the chief physiotherapist, gave him a thorough course in muscle training exercises. In four months, the stumps became firm and muscular. Henry could raise them to a horizontal position. He was ready for artificial arms.

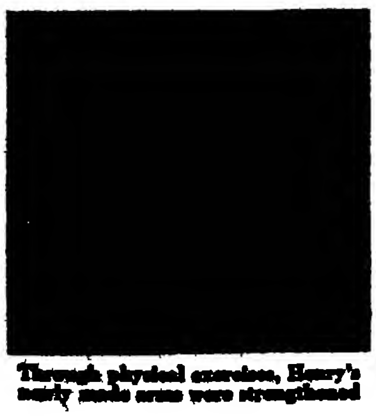
Just before Christmas, Henry received his new artificial arms and came to the hospital dressed in a new suit and shirt, both of these garments having sleeves—the first sleeves Henry had ever had. "With his new arms in these sleeves," says the doctor, "he looked like any ordinary healthy boy, but I doubt whether there was ever a prouder or happier child. Within a half hour, he was able to grasp a pencil in the clamp attachment at the end of his right arm, could write better than most boys of his age and could draw better than when he held the pencil between his right cheek and shoulder A little later, he returned to the Spaulding School, and just before entering Miss Neil's office, he asked Miss Carney to throw his overcoat over his left arm and place his cap in his left hand. Then he marched in and put out his right hand to his friend, the principal, 'just like a gentleman' as he expressed it. That noon at luncheon at the school, he grasped a spoon in his right hand and ate like other boys, instead of 'lapping his food like a kitty'"

"From all accounts," continues the surgeon, "his homecoming that evening and the surprise he gave his mother, who did not know that his artificial arms were ready and who had never seen his new suit, was very impressive. It must have been, for it is impossible to describe the choky sensation that a number of us doctors had that day at the hospital as Henry displayed his 'first sleeves, and sleeves with arms in 'em'"

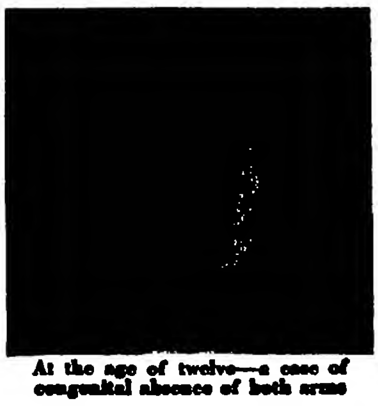
Henry can make his right transplanted pectoralis muscle stand out like a biceps, and he gets the same pleasure out of "making a muscle" as any boy does who flexes his arm. He now has a new pair of artificial arms, having outgrown his old ones. He paid for the new pair himself with money he made from the sale of his artistic Christmas cards which he designed and made from wood cuts. He has attended the Art Institute the last two summers and is becoming a real artist He does practically everything for himself

This case demonstrates the need of coordinating the work of reconstructive surgery and education, Dr Mock points out The two are inseparable in rehabilitating the disabled The surgeon has a great opportunity to inject ambition into his patient, to tell him of the accomplishments of others similarly handicapped, and finally to place him in the hands of those lay agencies which give a continuity of service that will assure the final economic end-result in every case of permanent handicap.

What has been done for this boy can be done for great numbers of congenital and acquired deformities in both children and adults. The study of these cases from the point of view of rehabilitation opens up new and exceedingly interesting avenues of surgery.



Through physical exercises, Henry's newly made arms were strengthened



At the age of twelve—a case of congenital absence of both arms

* * *

Synthetic Rubber, Is There Anything in It?

If the price of rubber stays up, sooner or later synthetic rubber will be sure to make its appearance, says *Industrial and Engineering Chemistry* (New York). It would appear that petroleum will be the cheapest source of the raw material Yet this technical journal holds out slim hope for a future synthetic rubber industry

What of synthetic rubber? Sharply conflicting statements concerning it pop up from time to time "It has never been successful commercially," say some. "It will soon be a big success," say others. Moreover, the situation has been confused in some instances by unscrupulous promoters of stock sales, who do not hesitate to promise riches to the "ground floor" investor in improved processes for making synthetic rubber

Whether or not rubber has already been made synthetically, depends, in the last analysis, on what is meant by rubber The word rubber, like many other terms, is elastic. If we conceive it to mean hard rubber, for example, then we can certainly say rubber has already been made synthetically What the world wants, however, is not some special kind of rubber having limited usefulness, but plain *rubber*—synthetic rubber that can be substituted successfully and satisfactory for the plantation rubber of rubber gloves, rubber boots, rubber balls, and especially automobile tires. Dodging all "ifs" and "ands," no such product, synthetically made, yet exists. But there is ground for hope, say chemists, who are at work on the problem

During the war, the Germans made two types of synthetic rubber The product of the cold process, known as "H" rubber, was successfully used for hard rubber articles, particularly submarine battery jars, but the product of the hot process, known as "W" rubber, never came into extensive use.

The Germans, it is stated, made their rubber from acetone, but nothing is positively known of the yield or the cost One estimate of the cost of materials is forty cents a pound The cheapest source of material is petroleum, although butyl alcohol and amyl alcohols may be employed.

Even should the price of plantation rubber fall to 25 cents a pound (the cost of production, plus a fair profit) synthetic rubber might have to meet this price in order to compete at all Although, so far, the raw materials have been too costly to make synthetic rubber a real competitor, the present high prices (ninety cents in January, 1926) if continued, will be a challenge to the laboratory, and one never knows from what test tube or from what catalytic bomb a

Harris & Ewing

Candy produced from corn by the new process developed at the United States Bureau of Chemistry

Harris & Ewing

Maltose sugar made from corn. That in the bottle on the right remains in the raw, lumpy state

revolutionary discovery may be brought forth.

Writing in the same journal (April, 1926) L. E. Weber, a Boston consulting rubber chemist, states that there is some difference of opinion as to whether or not it can be claimed from the commercial standpoint that crude rubber has been synthesized successfully

The manufacture consists of two distinct operations (1) the manufacture of the parent hydrocarbon, and (2) the polymerization of the hydrocarbon. (Polymerization, the change of molecular weight without change of percentage composition For example, benzene, C_6H_6, is a polymer of acetylene, C_2H_2.)

The first operation, the manufacture of the parent hydrocarbon, varies with the raw material used, whether coal tar, starch or petroleum If starch, the carbohydrates are converted into iso-amyl alcohol by fermentation. The iso-amyl alcohol is then converted by means of hydrochloric acid into an iso-amyl chloride, and the latter in turn is converted to the dichloride by means of chlorine Finally, passing the dichloride over soda lime yields isoprene

Another approach may be made by way of acetone, which it is hoped, incidentally, may some day be made from coal The acetone is reduced to pinacone by the action of aluminum and caustic soda, and methyl isoprene is produced from this by distillation under pressure.

Having made either isoprene or methyl isoprene, the second step is their polymerization. Either product is placed in steel drums and allowed to remain at a temperature of 140 degrees Fahrenheit. By another process, metallic sodium in wire form is added to the isoprene or methyl isoprene and the two are left together two or three months.

Examining synthetic rubber in the light of the conditions it must meet in order to compete with plantation rubber, the author quoted discovers that it meets the requirements only to a minor degree The elasticity and abrasive resistance of soft rubber articles at present produced from vulcanized synthetic rubber are comparable, if at all, to only the lowest grades of plantation rubber Synthetic rubber ages poorly Its plasticity is very deficient

On the other hand, the progress which has been made represents beyond question the greatest achievement of synthetic organic chemistry—it is the first and only natural organic colloid which it has been possible even remotely to duplicate in the laboratory Beyond question, he says, the synthesist will ultimately produce a product equal in quality to natural rubber "The dispassionate weighing of the facts," he continues, "prompts the conclusion that the synthesist has yet to devote much labor and effort before he can lay claim to having reached his goal, and under these conditions, the creation of an impression that synthetic rubber, if not actually near at hand, is at least within reach, is unfortunate because it arouses immediate hopes which cannot be fulfilled"

And the minute the synthesist produces synthetic rubber equal in quality to the natural product from some cheap raw material, the plant biologist, who has already shown us what he can do by increasing the natural 2 percent content of sugar in sugar beets to 18 percent, will loom up "with the rapidity of the prophet's gourd" and quash the infant industry Gloomy outlook "The chances of victory for the synthesists look slim," says *Chemical and Metallurgical Engineering* (New York), but the *India Rubber World* (New York) sees in the situation a little light, for says that journal, "even though costing 50 cents a pound, it should prove the best kind of a crude rubber stabilizer"

* * *

From Corn to Sugar in Ten Hours

"INSTEAD of sending their corn to market on the hoof—in the form of hogs and beef cattle—farmers, in the future, may market a fraction of this cereal crop via the sugar barrel route" says S R Winters. Sugar from corn is now possible in quantity production, two chemical processes having been developed for the commercial manufacture of sweetening from America's biggest grain crop.

Harris & Ewing

Making maltose sugar in the laboratory—the vacuum pan. The apparatus was designed by the Bureau of Chemistry

Methods for extracting sugar from corn are not new to chemists, but a revival of interest in the possibilities of corn sugar has been brought about by the surplus from the 1925 three-billion bushel corn crop, which is a depressing economic factor to the corn growers of the Middle West, and by a bill which is pending before Congress. This bill, if enacted, would admit of the marketing of corn sugar or dextrose on a par with sugar from cane and beets, without any distinguishing label.

The latter proposal is, however, being stubbornly contested by supporters of the Pure Food and Drugs Act, as well as by the manufacturers of cane and beet sugars. Dextrose, the product now being extracted from corn on a commercial basis, is said to be only 50 percent as sweet as sugar made from cane or beets. Dextrose is less soluble in water than cane or beet sugar and, according to claims, it has a flavor peculiarly its own

The bill introduced in Congress by Senator A B. Cummins and Representative Cyrenus Cole of Iowa would amend the Pure Food and Drugs Act so as to admit of the sale of dextrose, or corn sugar, without any label or differentiating mark from that of cane and beet sugars. This legislation, if favorably passed upon, would give corn sugar a rating, at least in the market places, commensurate with that of cane or beet sugar, though the latter is 100 percent sweeter Dextrose, a comparatively new commercial product, would, by virtue of artificial legislation, share the popularity which has so long been accorded to the old and standardized products from cane and beets—"sucrose" or sugar, if you please! Let every tub stand on its own bottom, in a measure, is the admonition of Secretary of Agriculture William M. Jardine and food administration officials of the Bureau of Chemistry, in their insistence that food products be properly labeled in accordance with the Pure Food and Drugs Act.

Supporters of the legislation favoring the liberalizing of the Pure Food and Drugs Act so as to admit of the sale of dextrose under the general classification of sugar are prompted by motives that are deserving of some consideration. Aside from its commercial aspects, that of artificially boosting the market value and consequent demands for corn sugar, such legislation is designed to

alleviate, though in a small way, the distressing economic factor of an overabundance of corn, without visible markets for the surplus.

Dextrose can be produced more cheaply than cane or beet sugar and therefore could be marketed at a correspondingly lower price than the standard sweetening. Thus, if we are to believe the arguments of the supporters of the Cummins bill, corn sugar would be used in appreciable quantities in the canning of fruits, vegetables, condensed milk, preserves, jellies, and in the manufacture of ice cream.

Meanwhile, our attention is drawn for the moment to a comparatively new process for the manufacture of sugar from corn which has been developed by the Bureau of Chemistry of the United States Department of Agriculture. By this process, "sugar" is made from corn starch or from corn hominy and is designated as maltose sugar It is not, therefore, to be confused with dextrose or connected with the legislation over the latter product which is now engaging the attention of Congress. Moreover, the Bureau of Chemistry is a strict conformist to the laws which it is empowered to enforce upon others—that is, it gives this corn product a distinguishing mark, maltose sugar, in deference to the will of the Pure Food and Drugs Act.

Mr Winters describes the process of manufacturing maltose sugar as follows "A vacuum pan, with its controlling mechanism, is the heart of the equipment, the mashing of the hominy with malt serving to liquefy the product and then completely convert the starch into white sugar This simplicity of equipment and procedure would seem to imply that farmers could make their own sugar, but the Bureau of Chemistry warns against the attempt because of the technique involved in controlling the apparatus However, it is not unreasonable to assume that with a further simplification of this control, educated farmers, trained in the laboratories of our agricultural colleges, would be competent to manufacture sugar

Of the process of making maltose sugar from corn, the United States Department of Agriculture speaks officially as follows

"That it is possible to make crystalline maltose sugar from corn starch has been known to chemists for many years, but control of the process has been lacking, and it has not been possible heretofore to produce crystalline maltose sugar from starch economically The new method enables the chemist to control the process so that it proceeds with regularity and certainty The process is simple and involves no unusual equipment. The final cost will be low, so that the maltose sugar can be produced at a comparatively low cost, as low or lower than cane sugar

"The new product is obtained in the form of fondant-like masses and not in a granulated form like granulated cane or beet sugar

Photographs courtesy Bell Telephone Laboratories

The projection machine for the new talking motion pictures. It is as easy to operate as the ordinary motion picture projector

It can be melted and cast in molds like fondant made from cane or beet sugar It may be used in the candy industry in producing chocolate cream centers and other cream confections.

"The process consists essentially of mashing either corn starch or corn hominy with malt, which liquefies the product and in the course of from 7 to 10 days completely converts the starch into maltose sugar After decolorizing with carbon and evaporating to a given density, the sirup is allowed to cool and is then inoculated with a little crystalline maltose and allowed to stand from one to several days at room temperature, when it sets into the solid crystalline fondant, the crystals being so fine that they can hardly be distinguished under a high-power microscope.

"This new advance in producing crystalline masses of maltose sugar from corn has yet to be industrialized so that it is too early to realize its bearing on the utilization of corn. The investigational work is not entirely complete but has proceeded far enough to demonstrate that it is entirely practicable to make an excellent grade of crystalline maltose sugar from corn starch or hominy"

* * *

Motion Pictures That Talk—a New Method

SCIENTIFIC developments which will revolutionize the presentation of motion pictures in the largest metropolitan theatres as well as the smallest theatres in the little towns have just been announced as perfected by the Western Electric Company and Warner Bros. Pictures, Inc These developments are the result of years of research in the Bell Telephone Laboratories, the research laboratories of the American Telephone and Telegraph Company and the Western Electric Company They involve a system for the synchronization of motion pictures with reproduced sound having a degree of naturalness never before attained.

This invention brings to audiences in every corner of the world the music of the greatest symphony orchestras and the vocal entertainment of the most popular stars of the operatic and theatrical fields. The recording and reproducing system is available to all motion picture producers for synchronization with any film that they produce. Its use is not confined by any means to the presentation of pictures It will be available for use in the educational, commercial and religious fields as well as that of amusement.

Scientists consider this system to be a distinct advance not only in the motion picture field, but in that of voice communication as well The invention will make it possible for every performance in a motion picture theatre to have full orchestration accompaniment to the picture regardless of the size or character of the house A corporation has been formed to record the synchronization of music for motion picture producers all over the world and to distribute the invention among theatre owners.

The apparatus by which films and sound records will be simultaneously reproduced in motion picture theatres is no more complicated from the standpoint of operation than an ordinary motion picture projector No special skill or technique is required of the operator If the film breaks, there is no interference with the accuracy of synchronization The sound record is not controlled by the film itself

The system represents successful combination and conversion to motion picture use of three major research developments.

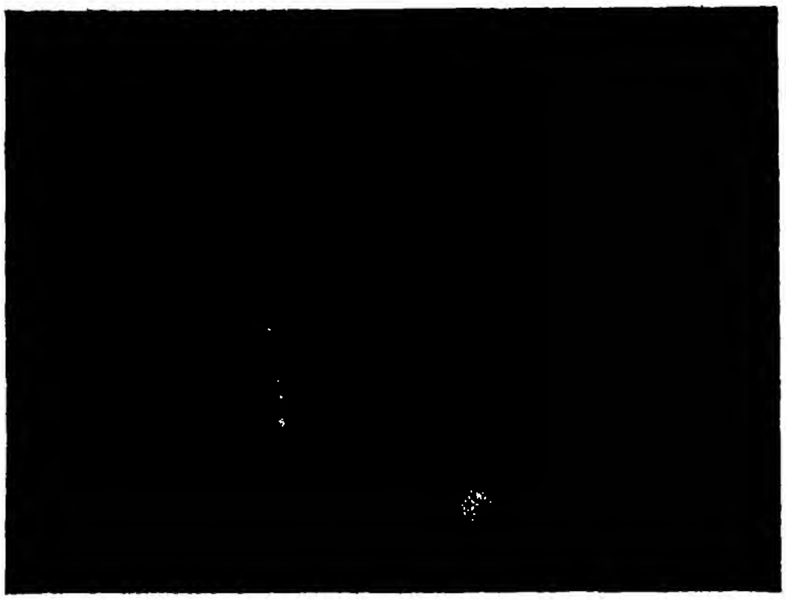
The first of these is the electrical system of recording. This method employs a high quality microphone of an improved type, electrical amplifying apparatus, and a record cutting mechanism. Recording may be carried on at a considerable distance from the source of sound so that the actors may be grouped naturally in any scene and need not be crowded before a microphone

The second essential feature is a remarkable electrical reproducer which converts the movements of a needle in the grooves of a sound record into electrical vibrations. The electrical currents from this device pass into an amplifier and then operate a high quality loud speaker of an improved type capable of filling practically any motion picture auditorium with sound

The third development is the link between the reproducer and the audience in a theatre. An adaptation of the public address system makes it possible to pick up electrical vibrations from the reproducer, amplify them, and by means of properly located loud-speaking telephones, to transform them into sound The loudness is so regulated as to give the illusion that the source is the actors whose

The sound-proof booth from which the pictures are projected. Were it not made sound-proof, extraneous noises would also be reproduced

The recording apparatus, showing the wax disk. The technician is shown examining the grooves in which the sound vibrations are recorded



Despite the ice which has formed on the opening of the tube, it still functions at full efficiency with only a tiny opening left unobstructed. Thus, cold weather flying is rendered more safe

Two types of tubes were tested. Gradually the ice narrows the opening but the tube must stay open as long as the airplane is able to fly with the coating of ice on the wings

pictures appear on the screen In the case of musical programs a specially constructed loud-speaking telephone insures the correct values and naturalness.

The combination of these three factors in a complete and effective system required the development of a mechanism for keeping the film and sound producing instrument in absolute synchronism, both during recording and during reproduction It was essential that the system be capable of easy operation in a theatre, without requiring special skill. To meet these requirements both the film and the sound device are set in their respective machines with a given marker in the proper place, and the two machines are then speeded up from rest, together by the simple device of having them coupled to the opposite ends of the same motor

The mechanism for taking the pictures with these markers on the original film and record could not be provided in so simple a manner, since the camera had to be left free to be moved about on its tripod to change the angle of view In this case two motors are used one to drive the camera and one to drive the sound recording machine An ingenious electrical gearing device has been developed whereby the two machines can be started from rest and maintained in synchronism not only after they are up to speed but during the period while they are speeding up

In developing the system it was necessary to perfect a method of making sound records which will run at least fifteen minutes without distortion either of the high or of the low notes. Through the use of two reproducing machines used alternately, interruption of the accompaniment will be avoided Reproduction in the theatre preserves the correct relationship of each sound to the others, the intensity varying in the same proportion as in the enacted scene or musical program

An important use of the new system will be for providing musical programs for motion pictures already taken This is accomplished by projecting the picture in the usual way and recording the music, as previously cued, in synchronism with the projection instead of in synchronism with the photographing Any picture which has ever been produced can be orchestrated and synchronized. The sound synchronization is not dependent on recording at the time of the exposure of the film.

One of the difficulties of producing talking motion pictures which had been encountered in earlier attempts lay in the necessity for keeping the artists close to the recording equipment in order that a satisfactory reproduction might be made, but the new process of electrical recording makes it possible to make faithful records at a distance from the source of sound

The most difficult part of the development was the reproduction of music or speech from the apparatus in such a manner that it would be as loud as music or speech from a real performance and at the same time would be a faithful copy in all respects. The special electrical device for converting the motion of the needle which bears on the record into electrical vibrations, and the use of a modified public address system, overcame these difficulties.

* * *

Unsung Heroes of the Air Service

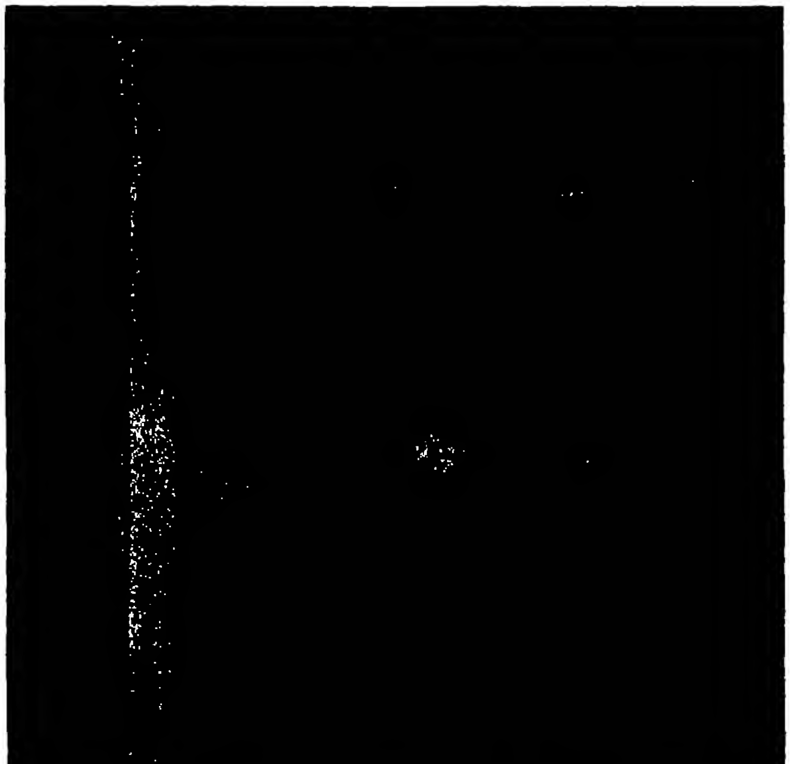
Few things could endanger the air pilot's life more than the failure of his speed indicator Without this guide the speed of the plane might imperceptibly decrease to the danger point producing a "stall," and resulting, probably in disaster

Among those who have taken peculiar risks to make aviation safe for the flyer is the man who tests aircraft instruments in a freezing rain, within a refrigerated chamber, during midsummer heat

The particular form of experimentation about to be described was unique in that freezing temperature, rain, sleet, a biting wind and all the discomforts of a flight through a storm were experienced indoors.

The experimenter worked in a refrigerated chamber, bundled up in a fur lined flying suit and other cold weather flying togs. Cold rain whipped across his face as he intently watched an air speed indicator in order to determine how water, freezing on the tube leading to the instrument, affected its functioning This was just one of the problems that is frequently met with in the development of aircraft accessories, especially in connection with the delicately constructed instruments.

One form of speed indicator used on airplanes makes use of an open tube, into which the air blows as the airplane moves forward The pressure generated causes the indicator to function This tube must necessarily be mounted on a wing of the plane in the free air stream Thus it is exposed to all sorts of weather If, in flying through rain, the air is cold enough to freeze the water that collects at the end of the tube, the ice clogs the opening so that the air cannot pass through The indicator then ceases to function So the immediate problem was to study the relative merits of various types of air speed tubes from the standpoint of their effectiveness in operating when exposed to freezing rain.



The apparatus used for testing air speed indicators. At both sides are refrigerating coils. The miniature tunnel shows in the cen—

A six inch, suction wind tunnel was constructed especially for the investigation and was operated in a refrigerated chamber. In the wind tunnel the air speed of actual flight was duplicated A vaporizer also sprayed water before the tunnel, simulating rain. To produce freezing rain, the chamber was cooled to five degrees, Fahrenheit

For many weeks the tests continued The tester sat before his apparatus, carefully taking readings from the indicator and intently watching the water collect and freeze on the tube. Often he would enter the test room from midsummer heat. Even during the month of July when the temperature was hovering around the 90s, he wore his fur-lined suit, heavy gloves and boots and stepped into the chilling blasts of his refrigerated laboratory Because of the extreme exposure for that time of year, he could stay there only a limited time—usually only a half hour—never more than one and one-half hours.

Success was the reward of this more or less personal endurance test Some sixteen different types of tubes were tried out in order to determine their functioning possibilities in freezing rain Of this number the most satisfactory results were obtained from the tube known as the Pitot-static. This type of tube has an opening of sufficient size so that by the time it is entirely ice-covered and fails to function, the wings and the propeller of the plane are themselves so thickly coated with ice that they can no longer function This is another way of saying that the speed indicator will continue to register as long as the plane can stay in the air.

Thus the testing of flying equipment on the ground has resulted in another discovery that will make the pilot's work more safe.

* * *

Doing a Thing That Could Not Be Done

After years of unsuccessful effort a way to join soft rubber directly to iron has at last been found. This will be especially valuable for attaching solid truck tires to their steel bases. Formerly a firm anchorage of a hard rubber layer to the steel was obtained by corrugating or grooving the steel and partially curing the hard rubber compound to it before the soft rubber compound was applied. The corrugations held the hard rubber and the hard rubber held the soft rubber

The new process hinges upon the use of a specially compounded cement-like product which is applied to the metal surface in a fashion similar to the application of liquid cement. Compounded rubber is then applied directly to the treated surface and vulcanized either by heat or air. The air-cure method is followed when the application is made to wood. The process is employed as effectively on wood as on metal.

In tests, a strip of rubber one inch square and six inches long was vulcanized to a steel beam and the combined weight of two men could not tear loose the one square inch of vulcanized end. To secure such power of adhesion between metal and soft rubber is in itself a noteworthy achievement.

The hard rubber method of joining rubber to metal was expensive and often impractical, if not impossible, to employ. Naturally, there was a difference of expansion between the hard rubber and metal base. This caused cracking and separation. In the new method the soft rubber expands or contracts with the metal and its adhering qualities are not impaired by sudden changes in temperature.

Soft rubber sheet applications have already been made, by means of this new process, to steel tank cars engaged in the transportation of corrosive acids, to the interior of pipes and pipe fittings used to convey both abrasive and corrosive liquids, as lining for chutes, hoppers, fan and propeller housings, and as coverings for fan and propeller blades. In many of these installations the soft rubber has extended the life of the metal beneath it to three or four times its previous normal life.

The new process also offers unmistakable benefits to the aircraft industry. It has been tried out successfully for covering aluminum airplane propellers. Pontoons and seaplane floats, when covered with rubber by the new method become water and barnacle proof. This greatly extends the life of the frail structures which make seaplane maintenance so costly.

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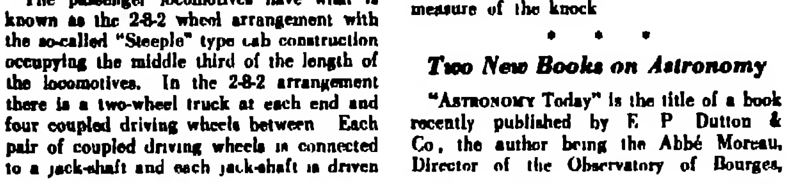
Powerful Electric Locomotive for Freight and Passenger Service

THE Pennsylvania Railroad is placing in service eight new electric locomotives to handle its heavy freight and passenger service. The design is so laid out that they may be utilized for either freight or passenger service and they can operate either on alternating or direct current by making slight modifications in the type and arrangement of the apparatus on the locomotives. When they are utilized for direct-current passenger service, as is the case in New York, they have a continuous rating of 3,730 horsepower, a starting tractive effort of 82,500 pounds, and a continuous tractive effort of 37,000 pounds when running at 37.8 miles per hour.

The passenger locomotives have what is known as the 2-8-2 wheel arrangement with the so-called "Steeple" type cab construction occupying the middle third of the length of the locomotives. In the 2-8-2 arrangement there is a two-wheel truck at each end and four coupled driving wheels between. Each pair of coupled driving wheels is connected to a jack-shaft and each jack-shaft is driven by motors which are mounted outside the frames as shown in the illustration. The connection between the motors and the jack shaft is by means of pinions and flexible gears. The driving wheels are 80 inches in diameter.

The engines weigh approximately 400,000 pounds, of which approximately 300,000 pounds is carried on the driving wheels—the balance being supported on the two-wheel trucks at the ends of the locomotive.

These handsome machines were built complete, so far as the mechanical equipment was concerned, by the Pennsylvania Railroad—the electrical equipment being furnished by the Westinghouse Electric & Manufacturing Company, and assembled in the locomotives at the Altoona Shops.



Photograph courtesy of the Pennsylvania Railroad Company

One of the new electric locomotives which have been placed in passenger service on the Pennsylvania Railroad. It weighs 200 tons

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Eavesdropping on Ethyl Gasoline

GASOLINE treated with lead tetraethyl is being studied at Massachusetts Institute of Technology in an engine in which research workers can see the process of combustion and the flames of the explosion, says *The Technology Review*.

The effect of lead tetraethyl in eliminating knocks in gasoline engines has been known for a considerable time, but hitherto little was known of what took place when the lead-treated gasoline was exploded in the cylinders.

In seeking a means of studying the action of lead tetraethyl in engines, workers in the laboratory of applied chemistry in charge of Professors G. L. Clark and R. P. Russell cut away a portion of the cylinder wall of a one-cylinder engine and replaced it with a small, heavy, quartz window designed to withstand the tremendous force of the explosions. The experiment was a success and it is now not only possible to watch the flames of the exploding mixture, but to photograph them with the aid of a revolving shutter in front of the window. A spectroscope was also used to evolve a spectrum of the light from the flames.

The first discovery in this investigation was that lead tetraethyl completely blots out the ultra-violet light rays in the detonating flames. On the basis of that discovery those in charge of the research are seeking to determine what relation may exist between engine knocking and the presence of ultra-violet light rays.

Measurement of the force of engine knocks is also being studied electrolytically. A plunger fitted in the top of the cylinder closes a circuit when a knock occurs and the length of time the circuit remains closed is a measure of the severity of the knock. The closed circuit is then used between electrodes for electrolysis of a solution of sulphuric acid of known strength. The amount of hydrogen thus produced is taken as a measure of the knock.

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Two New Books on Astronomy

"ASTRONOMY Today" is the title of a book recently published by E. P. Dutton & Co., the author being the Abbé Moreau, Director of the Observatory of Bourges, France. This book is a brief survey (250 pages) of the entire field of elementary astronomy but is not a textbook. It would both interest and instruct anyone having the desire to increase his understanding of general astronomy. Perhaps the reader who had previously covered some elementary textbook such as Todd's "New Astronomy" (the clearest without much doubt of them all) would obtain more from it than one who had not yet anyone who had read it would carry away a definite even if only a beginner's, comprehension of the whole field of astronomy.

"The Music of the Spheres" by Florence Armstrong Grondal (Macmillan 1926), is described as "a nature lover's astronomy." If one cares to learn the constellations of the stars by the roundabout route of learning the mythology of the ancients about them, this book is one of the most attractive, both in style and production, of its kind. It also contains occasional statements of fact concerning modern astronomy painlessly sugarcoated by poetic fancy. Not that poetic feeling is out of place in the study of astronomy. Far from it. Astronomy is itself a poem, and all the remarkable things that the science of spectroscopy is so rapidly revealing about the size and nature of the Universe are its stanzas. But this poetry is inherent in the stars, while that of the ancients was merely assigned to them.

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Shall We Have Smallpox Again?

THE United States has the unenviable distinction of reporting more smallpox during 1925 than any other country except India, namely, 43,193 cases, according to reports which have been received by the American Association for Medical Progress from the health officers of all but one state (Utah).

Most of the states do not report the vaccinal condition in cases of smallpox. In 17 states and the District of Columbia such reports are available for most of the cases—10,636 out of the total of 12,858 cases in these states. Among these, 9,660 cases or over nine tenths, had never been vaccinated, and 751 cases, about 7 percent, had been vaccinated from 7 to 50 years previously.

Thirteen states each reported more than 1,000 cases of smallpox in 1925. California leading with 4,921 cases, followed closely by Alabama (4,288) and Ohio (4,018). Indiana had 2,996 cases, Georgia 2,108, Washington, 2,004. North Carolina, 1,920, Tennessee, 1,805, Kentucky, 1,700, Illinois, 1,625, Wisconsin 1,517, Texas, 1,309, Mississippi, 1,216. All of the six New England states together had only 102 cases, 94 of which were in Rhode Island.

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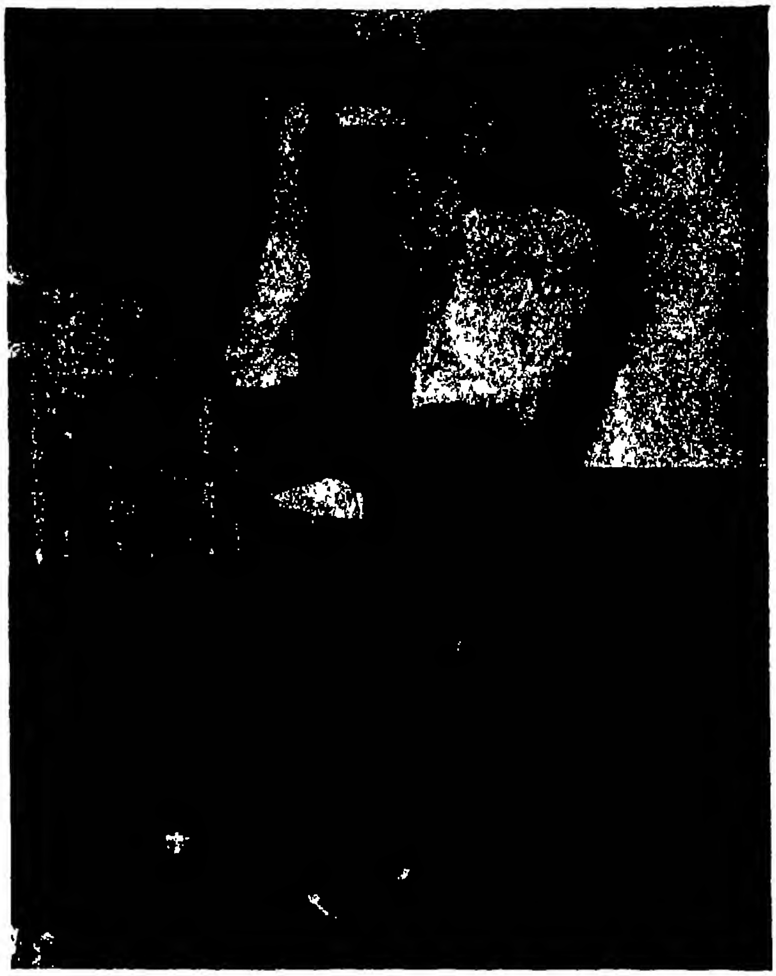


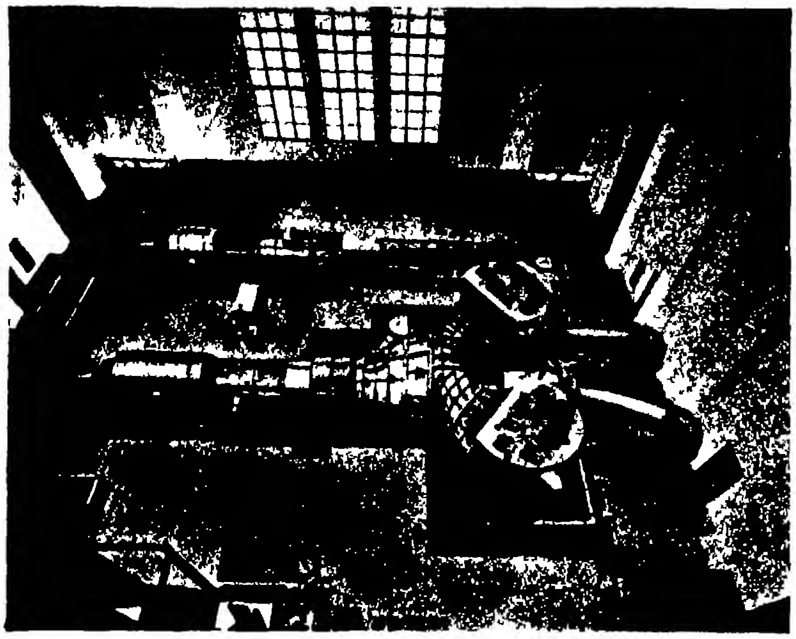
A small strip of rubber attached directly to steel by a newly discovered process. Until recently this could not be done

Parsons 50,000-Kilowatt Turbo-Alternator for Chicago

WE present a remarkable photograph of the 50,000 kilowatt Parsons turbo-alternator which has just been installed by the Commonwealth Edison Company of Chicago in the Crawford Avenue Station. This machine was ordered from England in accordance with a commendable policy of the Company, under which they have from time to time installed a single representative of the best European practice. The view is taken from the overhead traveling crane looking down upon the floor, and it shows in great clearness the main features of the installation.

Steam is fed at a stop valve pressure of 550 pounds per square inch and a temperature of 750 degrees centigrade, to the high-pressure turbine, which is seen on the further side of the floor. The turbine is direct connected to a 16,000-kilowatt alternator. The steam from the high pressure turbine is reheated and delivered to the intermediate pressure turbine (seen in the center of the nearer group), which is direct-connected to a 29,000-kilowatt alternator (shown to the left). The exhaust from the intermediate turbine passes to the low pressure turbine.

The pipe between the intermediate and the low pressure turbines is made in the form



A new 65,000 horsepower turbo-alternator which was recently installed at Chicago. It is one of the world's largest

of a double walled cone the steam flowing through the annular opening between the two walls. The exhaust from the low pressure unit passes to two vertical condensers by means of two heavily ribbed structures.

The high pressure turbine runs at 1,800 revolutions per minute and here the steam is expanded from 550 pounds to 100 pounds gage. Part of the steam is led to the third stage feed heater but the bulk of it is conveyed to a reheater in the boiler house where the temperature is raised to 700 degrees Fahrenheit and thence the steam is passed to the intermediate pressure turbine which it enters at a pressure of about 105 pounds absolute exhausting at about two pounds absolute.

Although the intermediate and high pressure turbines are in the same axial line they operate independently the low pressure turbine running at 720 revolutions per minute and driving a 6000 kilowatt generator. In addition to reheating the thermal efficiency of the set is increased by progressive heating of the feed water by steam bled from different stages of the turbine.

As showing the magnitude of this unit it should be mentioned that the total steam entering the turbine is about 420 000 pounds per hour. Furthermore because of the great expansion that has taken place the volume of the steam delivered to the condenser is enormous amounting to about 72 000 cubic feet per second.

Necessarily the various parts of this great turbine run to large figures the high pressure element weighing 103 long tons the intermediate pressure 147 long tons and the low pressure element 148 long tons, making a total of about 400 long tons for the whole turbine.

When the turbine was completed at the shops of the Parsons Company there arose the problem of how best to ship the machine to Chicago. There were three alternative routes. First by the Mississippi and the Chicago Drainage Canal, second by the Hudson River and the Erie Canal and lastly by the St Lawrence River and the Great Lakes. The Mississippi was not available because of the shallow draft, and the overhead bridges of the Erie Canal would not permit any of the barges taking packages of the size of those to be transported to pass. The Erie Canal had its drawbacks, largely connected with barging and transshipping arrangements, so it was decided that the only practical route was by way of the St Lawrence River.

To transfer the huge packages from the ship at Sorel Quebec, it was necessary to use the sheerlegs of the Government at their yard at Sorel Quebec. The Atlantic passage was a rough one and every day a careful inspection was made of the packing shores and of the tightening up of wedges, et cetera. At Sorel the bed of the river had to be dredged to enable the stern of the steamer to get alongside.

It took a week to discharge and another week to load the turbine on a lake boat and it took a week to get to Chicago, for the boat was built to the absolute capacity of the locks with a clearance in length of about one foot and on the beam of about four inches. The heavy packages were discharged at Chicago thanks to the difference in stowage arrangements of the holds in ocean and lake ships in about half the time that it took to load them—the lake boat having no shelter between decks and with clear holds free of columns.

The ship was unloaded by means of one 60 ton steam crane on the wharf and a temporary set of sheerlegs built of two 80-foot long beams. Then came the journey of five to six miles by special train to the Crawford Avenue Station which was done at a speed of about one mile an hour. The car carrying the heaviest section had to be strengthened and the load enroute fouled the buildings. When that happened the railway gangs shifted the bed over until the loads were able to clear and then swung the lines back into their original position.

This plant is the third of three new plants at this station the first being a 50 000-kilowatt reaction turbine built by the Westinghouse Electric & Manufacturing Company and the second a 60 000 kilowatt impulse turbine built by the General Electric Company.

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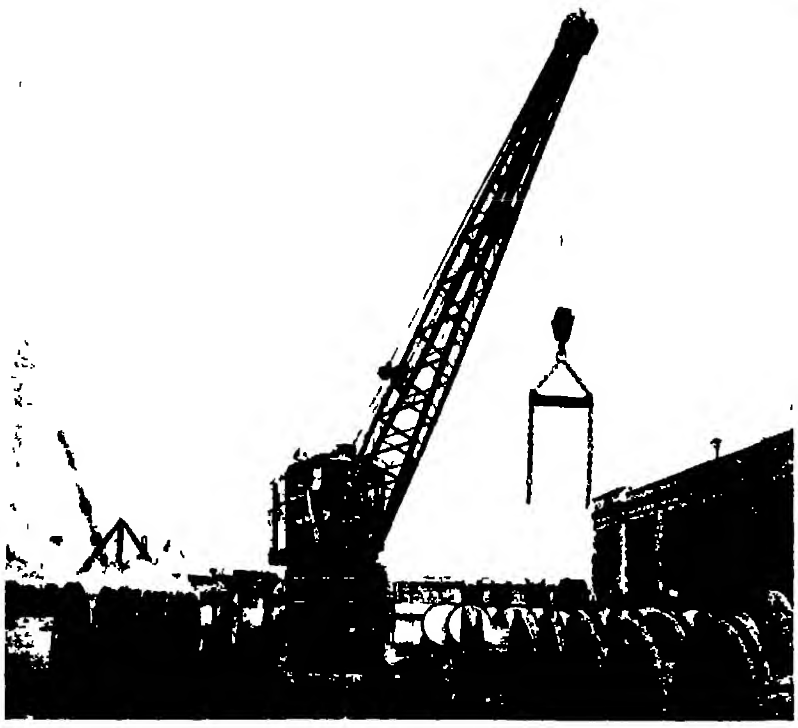

A new electric crane, driven by a storage battery which keeps the crane at work a whole day at a time

Something New in Traveling Cranes

AMONG the many designs of traveling cranes the one shown in the accompanying picture is, so far as we know unique. Its novelty as will be seen at a glance consists in the fact that it is driven by an electric storage battery which forms part of the outfit and therefore travels with the crane. In other words, the crane is self-contained. It is carried upon two four wheel trucks, and immediately upon the platform are mounted massive batteries. The turntable, resting upon a central steel superstructure, is at a sufficient height to give the crane full clearance above the batteries.

The whole outfit weighs a little over 100 tons, and the machine can hoist a load of 10,000 pounds at a speed of 80 feet per minute. Power is derived from the 100-cell storage battery of 1,080 ampere-hours at 230 volts. This battery has sufficient capacity to enable the crane to do a maximum day's work without recharging. The direct-current generator for charging purposes is the shunt wound type, 170 kilowatts, 260 to 300 volts, direct connected and driven by a three-phase, 60-cycle, 295 horsepower synchronous motor, at 1 200 revolutions per minute.

At the Kearny shops of the Western Electric Company where the crane is in service, the charging voltage is maintained constantly at 260 volts and the charging rate is determined by the charge on the battery plates. Once a week the battery is filled with water.

The crane has a capacity to lift a 10,000-pound load in a radius of 50 feet, and this enables it to lift the heaviest reel of lead covered cable. The crane has a traveling speed of 350 feet per minute and, when traveling light it will rotate at three revolutions per minute. A 100-horsepower, 230-volt motor supplies the power for traveling, hoisting the boom and reeling in the bucket or hook block through several trains of spur gears. The rotating is done by a 25-horsepower 230-volt motor. A 19,400 pound counterweight is installed in the tail of the superstructure. We are indebted to the Brown Hoisting Company the builders of the crane for the accompanying photograph and the data.

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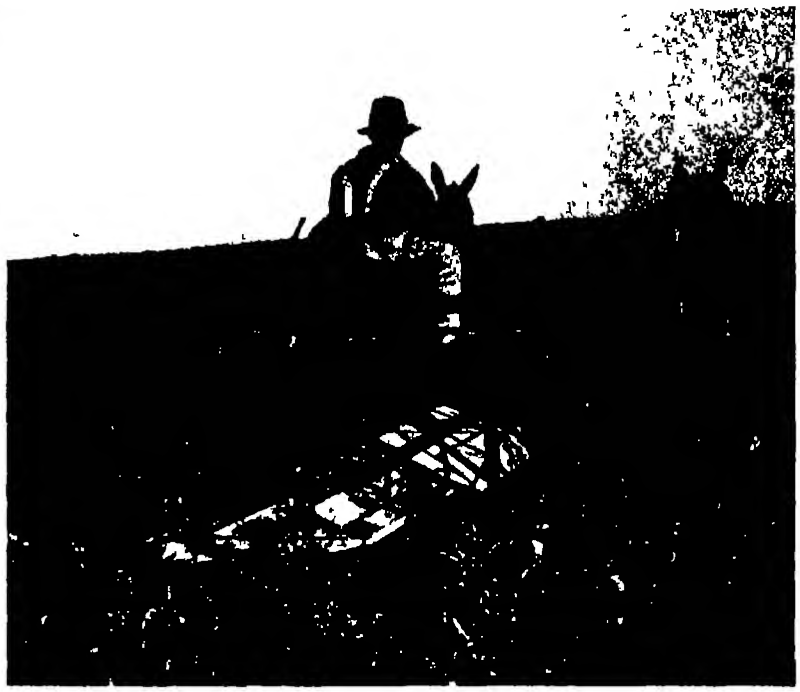


The cotton boll weevil exterminator at work in the field. It sweeps the weevils into poisoned pans

Sweeping Up Cotton Boll Weevils

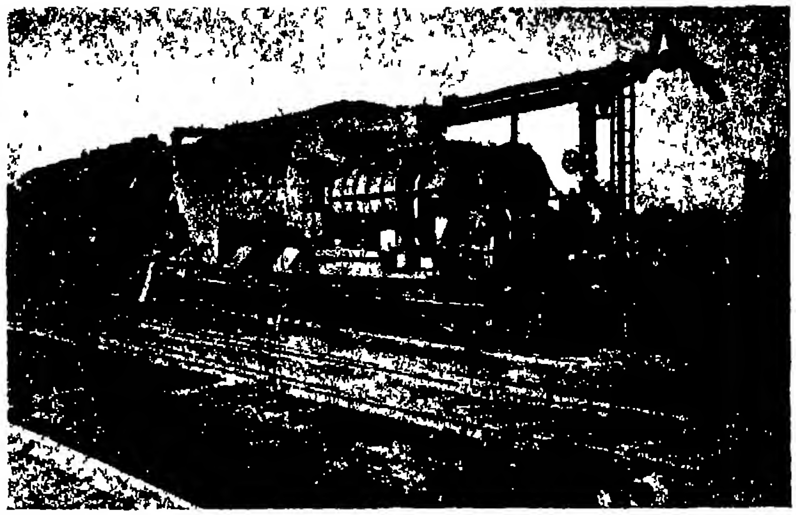
AN interesting machine for exterminating the cotton boll weevil, which does six hundred million dollars' worth of damage annually, has been perfected by two San Antonio Texas inventors. The new device is a structural steel frame mounted on two wheels like a sulky hay rake. Below the body is a long galvanized steel pan, containing an element which kills insects. On either side is an angular deflector which draws or bends the plants over the pan. On their rear portions beaters of perforated galvanized steel smooth as glass are hinged. The machine treats two rows of cotton plants at one time.

As contact is made with the cotton plants the weevils fold their legs against their bodies, falling into the killing element.

As the machine advances, the plants pass

(Continued on page 58)


"Never!"
"YOU know very well I like you," she said, "but—"
"But what?" he demanded quickly.
"But marry you—never!" she said simply. "There's something about you that I could never put up with."
"And what's that?"
"Oh, well, let's not discuss it—at least not tonight. Sometime I may tell you—still, maybe never."
* * *
You, yourself, rarely know when you have halitosis (unpleasant breath). That's the insidious thing about it. And even your closest friends won't tell you.
Sometimes, of course, halitosis comes from some deep seated organic disorder that requires professional advice. But usually—and fortunately—halitosis is only a local condition that yields to the regular use of Listerine as a mouth wash and gargle. It puts you on the safe and polite side. Moreover, in using Listerine to combat halitosis, you are quite sure to avoid sore throat and those more serious illnesses that start with throat infections.
Listerine halts food fermentation in the mouth and leaves the breath sweet, fresh and clean. Not by substituting some other odor but by really removing the old one. The Listerine odor itself quickly disappears.
This safe and long trusted antiseptic has dozens of different uses; note the little circular that comes with every bottle. Your druggist sells Listerine in the original brown package only—never in bulk. There are four sizes: 14 ounce, 7 ounce, 3 ounce and 1½ ounce. Buy the large size for economy.—Lambert Pharmacal Company, Saint Louis, U. S. A.
For HALITOSIS use LISTERINE
A Challenge
We'll make a little wager with you that if you try one tube of Listerine Tooth Paste, you'll come back for more.
LARGE TUBE—25 CENTS



The new railroad ballast cleaning machine. It virtually launders the broken stone and returns it to the track cleaner than hand-cleaned ballast

from the rear of the deflectors, and are bent under the beaters. These are driven by pit mans which are actuated by cranks situated above them. These beaters give the plants four or five violent shakes. The power for moving the beaters is obtained by the tractive effort of the wheels

* * *

Pneumatic Railroad Ballast-Cleaning Machine

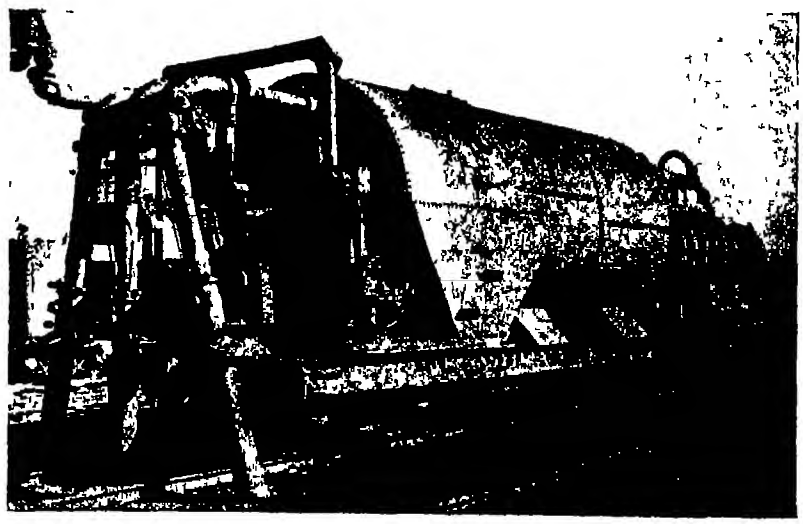
THE maintenance of the roadbed and track of a first-class railroad carrying heavy traffic is one of the most expensive items in its operation. On a new stretch of roadbed the broken stone ballast which supports the ties is sharp and clean and offers free drainage for the rain which falls upon it. Moisture finds its way quickly to the subgrade and thence into the side ditch. But, in the course of time, the continual falling of cinders and dust upon the ballast, fills up the interstices and the mass becomes matted together, thereby preventing the free drainage of rain and snow. Periodically, it is necessary for the section gang to clean the ballast, loosening it up with pick and shovel, removing as far as possible the accumulated dirt, and replacing it below and around the ties. Because of the high cost of labor, this work and the general maintenance of way is one of the most expensive operations on a railroad.

We present two views of a simple device, by means of which the slow and expensive methods of track cleaning by hand labor will be replaced by mechanical power with a reduction of cost of about 50 percent. The pneumatic ballast-cleaning machine, as it is called, was designed by Mr George Ehrenfeld for the Pennsylvania Railroad Company on order, and it has been put into service on the main line of the road—about five miles east of the Harrisburg station. The equipment is mounted on a special steel flat car built by the Pennsylvania Railroad Company, which is 10 feet wide, 48 feet long, weighs about 40,000 pounds, and has a carrying capacity of 150,000 pounds. The main elements consist (right to left in the pictures) of a steam turbine, a positive pressure blower and a large cylindrical expansion chamber.

The equipment car weighs about 110,000 pounds empty, but while it is in service, it carries an additional load (temporarily) of 15 to 20 tons of ballast and refuse. Power is obtained from the locomotive (steam at 205 pounds pressure) and is carried over by a pipe line to the steam turbine, which is of 250 horsepower and runs at 2,050 revolutions per minute. From the turbine, through a flexible coupling, the turbine operates a worm-gear reduction unit which drives a positive pressure blower at 175 revolutions per minute. This blower generates a high velocity current of air at 20,000 cubic feet per minute at a velocity of 18,000 feet per minute.

The pressure blower is connected to the expansion chamber, which is 10 feet in diameter, 20 feet long and weighs 26,000 pounds. During operation there is a steady rush of air through this chamber. At its forward end are connected three steel pipes, as shown in one of the illustrations. These pipes have a lateral oscillating movement and they are arranged so as to telescope vertically. They can cover a width of thirteen feet across the roadbed. These adjustable pipes suck up the material down to a depth of seventeen inches below the surface of the rock ballast.

In operation, the first thing is to lower into the ballast the three scarifiers or steel forks which are carried on each side of the car at its mid length. The locomotive then pulls



The ballast is sucked up through the three large pipes shown, passes through the large chamber and is returned clean to the right of way

the operating car, that is, the ballast machine, along at about ten miles per hour for as great a distance as may be desired. Then the scarifiers are drawn up to the body of the car and securely locked in position.

The next operation is to back the locomotive away from the car for a distance of twelve feet, so as to secure working clearance, and the three oscillating pipes are then telescoped down into the loosened ballast of the roadbed. Then a switch is thrown and the blower starts into action. Under the enormous suction, the rock ballast itself and the dirt, bolts, nuts, refuse, etc., are sucked up from the roadbed through the three oscillating pipes, at the rate of about 150 tons per hour, and discharged into the expansion chamber, where the rock ballast is thoroughly cleaned by air and is then discharged back to the roadbed on either side of the rails through two heavy slowly rotating air locks. The refuse is deposited temporarily in the lower part of the expansion chamber. The final operation is to draw the refuse out of the chamber and deposit it in a car attached to the rear of the work train.

When the ballast machine is in service, it is drawn slowly along the rails by two steel cables attached to the pilot of the locomotive—the ballast and refuse being meanwhile drawn up, separated, cleaned and finally returned to the roadbed at about twelve feet from the point at which it was sucked up. The complete cycle from drawing up the ballast to returning it to the track requires about twelve seconds of time, and the work of cleaning, et cetera, is performed automatically.

When it is necessary to clear the rails for traffic the machinery is stopped, the pipes are telescoped up out of position, and the carriage carrying the pipes is drawn back into the cab, thus clearing the coupler. The cables are wound upon steel drums and the locomotive couples up to the forward part of the ballast car and takes it to a siding. The time required to clear for traffic is about ninety seconds. Two men are required on the machine and it cleans up about one mile of single track in ten working hours. The cost of upkeep is negligible, since the rock ballast is actually floated on the column of air and does not come in contact with the pipe lines unless the equipment is forced beyond its normal capacity.

• • •

Another Plan for Getting Power from the Ocean

ACCORDING to the German correspondent of *Industrial and Engineering Chemistry* (New York), a German scientist, Dr Brauer, has recently proposed to utilize the enormous supplies of heat latent in sea water. On the surface of the sea the temperature of the water in large areas of the tropics, as well as in certain parts of the temperate zones is at least 77 degrees, Fahrenheit, the year around, while the water remains perpetually below 50 degrees at 600 to 1,200 feet depth in the same regions.

In order to utilize this comparatively limited difference or gradient in temperature it has been suggested that carbon dioxide or ammonia be evaporated with the warm surface water. The vapor pressure thus generated would supply the force to drive some form of engine, such as a steam turbine. The exhaust would be condensed in the cold water of the depths and the gases would again be put under pressure by the warm upper layers of water. Thus there would be a continuous cycle. In principle, there is little difference between this plan and steam turbine practice, and there is no doubt as to the theoretical possibility of such a power plant.

Economically, however, the question becomes more serious. The power sources are far from the localities in which they would, at least at present, be likely to be used. One plan for transferring the energy thus generated to the centers of civilization is to produce electric current by means of it and with this to obtain atmospheric nitrogen.

Learning to Use Our Wings

Aircraft are being put to use in peace as well as in war. This department will keep our readers informed of the latest facts about airships and airplanes

Conducted by Alexander Klemin

In charge, Daniel Guggenheim School of Aeronautics, New York University

Metal Construction

DEWOITINE, a famous French constructor, lecturing before the London Institution of Aeronautical Engineers, makes a strong plea for metal as the only practical material for the airplane.

It is a peculiar thing that in the early stages of any engineering development, wood is always the material resorted to. The automobile is a modern and striking instance of this tendency. The reasons are not far to seek. Wood is easy to work, it requires less skill of the engineer and above all construction in wood is easy to modify. The pioneers of the airplane calculated very little, relying largely on intuition. Their plan was to build as well as they knew how, fly their machines as quickly as possible, and change them after test.

Now that technical knowledge has increased enormously, it is possible to predict almost exactly what an airplane will do. Much greater care is given to the design, but the construction changes only slightly on the trials. Therefore the ease of modification of wood construction loses its advantage.

Wood construction is also cheaper than metal construction. Particularly for the first or trial ship, the cost of the structure in wood is less than 50 percent that of the metal airplane. But in large production this initial cheapness disappears. With metal alone is it possible to use the rapid methods of modern industry.

Also, metal alone promises long life and low depreciation. Not only is wood itself subject to organic change, but wherever wood is used in the airplane, glue is likely to intervene. For example, in large wooden beams or wing spars, glue is largely used to fasten the flanges of the beam to the webs. And in a year or so the glue may entirely disappear! Wood screws alone remain to maintain the spar, and the danger in flying under such conditions is self-evident.

With wood construction there must always be a certain amount of play; tolerances must remain large. Therefore a wooden airplane requires careful, individual adjustment. With metal, tolerances are much smaller, assemblies are rigidly riveted together and *stay put*.

Further, while wood is for its weight perhaps as strong as any material we have, it is possible to build lighter in metal, because in metal we have a homogeneous, reliable substance in which far greater structural refinement is possible.

Also, with metal it is probable that fabric will entirely disappear. Thin sheet duralumin is gradually displacing fabric as a wing covering, and instead of representing so much dead weight, it may even, by skilful design, be made to contribute to the strength of the wing as a whole.

M. Dewoitine makes out a very strong case.

Aeronautical Meteorology

IT is interesting to see that the Ronald Press has published Gregg's "Aeronautical Meteorology," one of the first books in the English language dealing with this subject. The author in his preface states quite correctly that a knowledge of the characteristics of the atmosphere is indispensable to the development of aeronautics. The promoter of air lines can only guarantee schedules if he has definite data on wind and weather conditions along a proposed

Pacific & Atlantic

Chief Petty Officer Lyman Ford, one of the Navy's nerviest parachute jumpers, leaping into space from a flying plane. One grim look at distant terra firma and two thousand feet to travel, with no protection from death but the parachutes strapped to his back and stomach, does not deter him

Pacific & Atlantic

He's off, and tugging desperately at the ring at his breast that will release the parachute pack. The emergency ring and pack over his stomach is available in case the first fails to open. The photograph was made within two seconds after the jumper left the plane and shows him falling at the rate of 64 feet per second

airway, and insurance companies cannot fix premiums without similar information To pilots the prediction of weather is of vital importance Gregg's book is just the text to supply the essential elements of meteorology and it is clear, simple and accurate

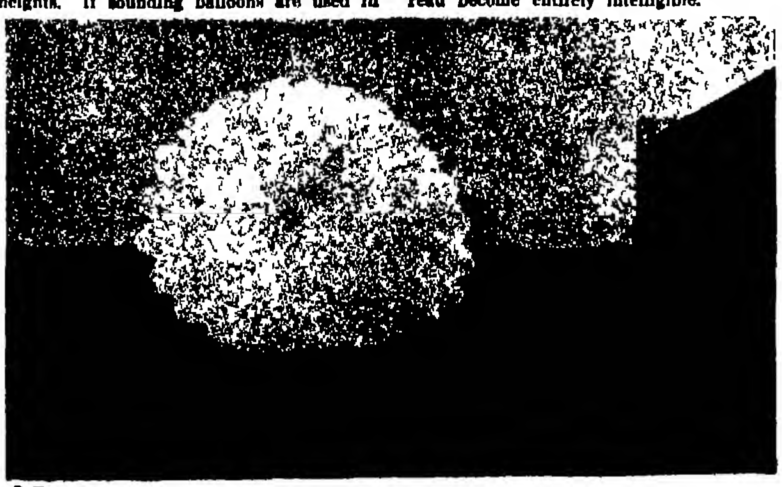
Why does the Air Mail Service maintain a faster schedule from San Francisco to New York than from east to west? Because the meteorologist has shown the prevailing winds to be such as to help the pilot on an eastward journey

The modern meteorologist is just as interested in the upper atmosphere as he is in the conditions near the ground Only thus does he get a comprehensive picture of the weather, and only thus can he help the aviator whose flights may be made at altitudes of 20,000 feet or more. The weather expert has been able to obtain information on atmospheric conditions at nearly ten miles above the earth's surface.

In this work real ingenuity has been shown Sounding balloons of very light fabric, six inches in diameter when uninflated, 30 inches in diameter when inflated with hydrogen, carry a complete set of self recording instruments to these astounding heights. If sounding balloons are used in pairs, one of the balloons finally bursts and the other brings the instruments slowly to earth. If a single sounding balloon is used, a parachute comes into play when the fabric finally fails, after having reached its maximum distention. Nothing is quite as exciting as the examination of the records of one of these aerial laboratories, which the scientists only recovers by offering a reward and clearly marking this fact on the instrument container!

It gets colder as we go up But not indefinitely It is a curious fact that a vertical section of the atmosphere shows a drop in temperature up to a height of seven and a half miles, to as low a point as -55 degrees Centigrade This region is the *troposphere* and is characterized by cloudiness. Beyond this altitude the *stratosphere* shows no cloudiness and the temperature ceases to diminish Academic in interest so far, but nevertheless fascinating to consider is this division of the atmosphere into two distinct regions.

Prediction of weather, fogs and rain becomes an intelligent possibility, if the few simple laws of meteorology are learned The peculiar looking maps of the Weather Bureau become entirely intelligible.



Pacific & Atlantic

And then the landing. This is not as easy as it looks, for even with a parachute, the jumper is travelling at a rapid pace and the fall must be met with all muscles relaxed. When the ground is hit the jumper is wafted along in the fashion of a huge and wind torn kite

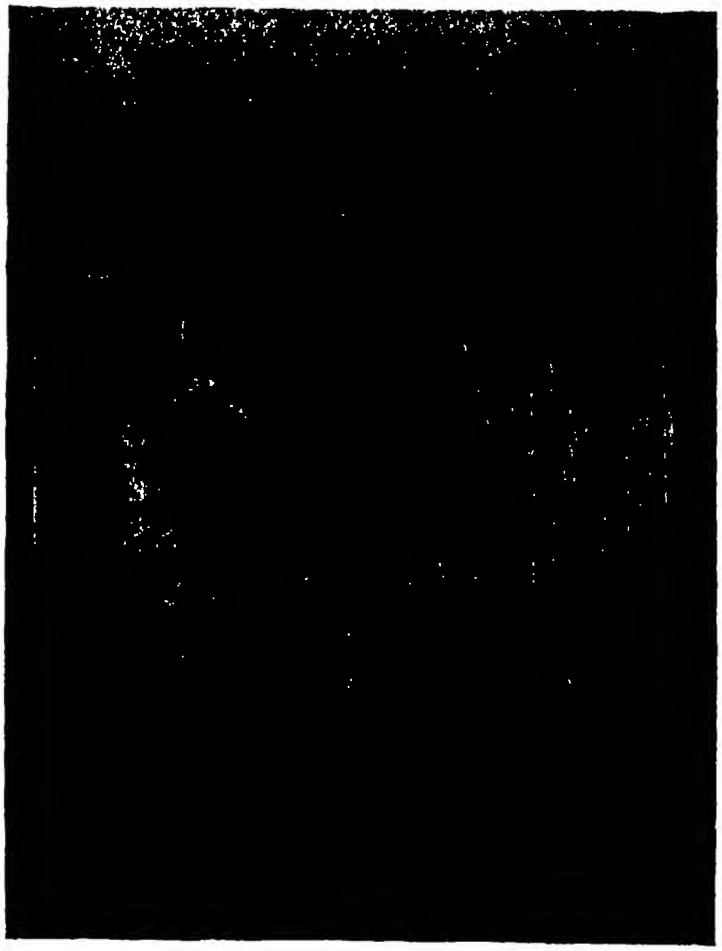
Aviation Medicine

"AVIATION MEDICINE," published by the Williams & Wilkins Company of Baltimore, is written by Dr L. H. Bauer, Commandant of the United States Army School of Aviation Medicine and perhaps the foremost authority on this subject in the United States. It is the first complete treatise on aviation medicine ever written in the English language. This splendid book is full of interest not only for the flight physician, but for every one interested in the progress of aviation, since on the selection of the aviator and on his continued fitness depends safety in flying to so large an extent We cannot resist quoting a few of the fascinating high spots of this book.

"A flyer who has good eyes, is sound physically, and who takes care of himself will last a good many years." Still age has a greater effect on the flyer than on men in other occupations. "Few flyers over fifty years of age will ever be found flying their own planes." Ten to fifteen years is the practical limit of a flying career

The eye is all important in piloting. Judging distance is perhaps the most important task of the eyes. "A pilot is constantly being called upon to judge distance. He does so particularly when leaving the ground, when flying in formation and again on landing In the last instance leveling off too soon, too late, or misjudging distance from trees, buildings or other obstructions may be fatal." Many varied methods have been devised for testing judgment of distance, with adjustable rods, wires or plates of glass as the "measuring sticks." The flight surgeon has to be as ingenious as the engineer in this type of work.

Equilibrium is all important in flying where loops, barrel rolls and Immelman turns impose every conceivable position on the pilot. Eye and ear and every other means of perception come into play, and it is the combined sensations of every kind that give the brain correct judgment. The subject bristles with difficulty and controversy. It is a pity that the Ruggles orientator, developed during the war, has not been utilized in peace time. "Briefly, the apparatus consists of a cockpit of an airplane suspended in three concentric rings. It is operated by motors and is controlled by a stick and rudder in the cockpit or by a stick and rudder in the instructor's chair on the ground. By a combination of movements of the stick and rudder, the orientator can be put through any evolution that a plane can be put through, except straight forward or up and down motion It can be looped, rolled, spun. . .These movements are similar to those made by a plane except that they are made at a greater angular speed." We are indebted to the publishers for a photograph of the orientator.



The Ruggles orientator which was developed during the late war

Reaction time tests and curious self-balancing tests, where the subject stands on one leg, flexes his other leg at a right angle at the knee and maintains this position for fifteen seconds, may sometimes be productive of amusement, but they are quite serious in their significance to the man who is applying for flight training in any air force.

While Macready is trying to reach altitudes of 40,000 feet with every available device at his command, it is sad to read again the story of Tissandier's famous balloon ascension in 1875. Tissandier, the sole survivor of the ascension to 28,820 feet, describes his sensations: "At 24,000 feet the condition of torpor which overcomes one is extraordinary Body and mind become feebler little by little, gradually and insensibly There is no suffering. There is no thought of the dangerous position, one rises and is glad to be rising." Tissandier failed to take hold of the oxygen tube, and became insensible at about 26,000 feet. His survival was a miracle.

There are, in principle, three methods of testing pilots for their ability to endure altitude conditions. "First we have the low pressure chamber. This is a steel chamber controlled by a vacuum pump which forces a constant stream of fresh air through the chamber. In simulating ascent the air is pumped out faster than it is allowed to enter and in simulating descent the air is permitted to enter faster than it is pumped

Wide World

Parachute flares used in landing a dirigible

out. Any altitude may be maintained as desired . . . We may use a nitrogen dilution apparatus. In this the subject breathes a stream of air in which there is a steadily increasing percentage of nitrogen. The barometric pressure remains the same, but the oxygen pressure is reduced by increased percentage of oxygen The third method involves the use of a rebreathing machine In this the subject breathes over and over again the same air with the carbon dioxide removed He burns up the oxygen, thus constantly reducing the percentage." These tests sound very unpleasant, and they do not have as compensation the thrill and glory of high altitude records

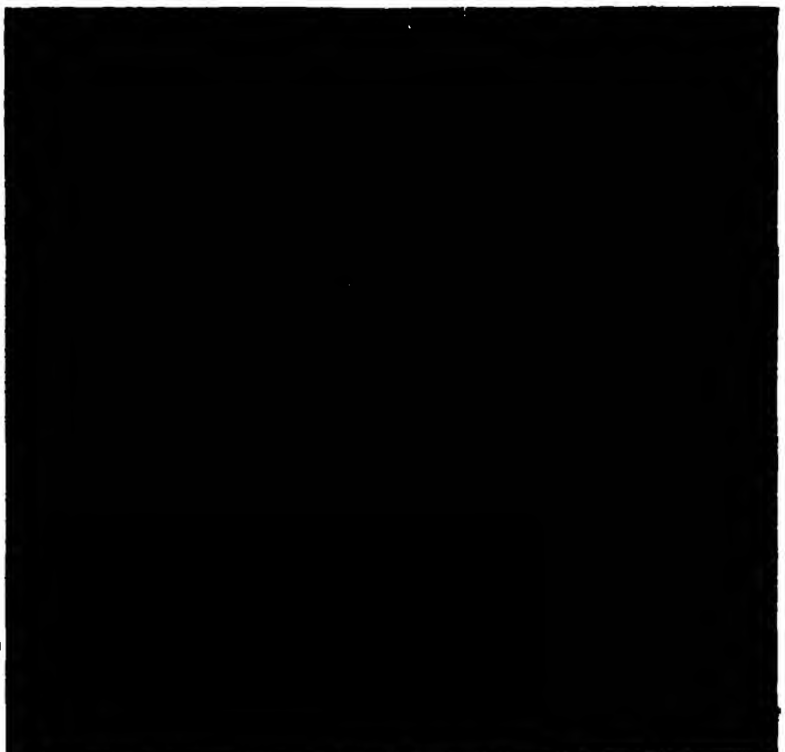
Major Bauer recalls the Pulitzer race of 1923 in which Lieutenant A Williams became unconscious when making turns. "That he must have been is evidenced by the fact that he went round an additional time, not being sure how many laps he had completed What is the explanation of this? It is believed the answer is centrifugal force . As the flyer makes a turn, the pull of centrifugal force is in the direction away from the pilot's head or towards his feet. .The blood is carried away from the head to his lower extremities Anemia of the brain, resulting in haziness, dizziness and even unconsciousness results."

The protective devices employed in altitude flying, the duties of the flight surgeon, the medical certification of the civilian pilot are among other interesting topics dealt with in a work which deserves careful reading

Parachute Flares

THE airplane embraces everything in its service For night landings and night reconnaissance work, fireworks, or in more dignified language pyrotechnic displays, have been pressed into service Sometimes flares are placed at the tips of the wings. Metal cylinders with asbestos plaster internal covering contain the pyrotechnic material which electric wires ignite very readily The flares are placed at some distance below the wing, and the fabric covering of the wing is suitably protected

Sometimes parachute flares are employed, placed in special racks in the plane and released by a simple Bowden wire control



Wide World

Flares are sometimes contained in metal cylinders with asbestos plaster internal covering

The parachute flare sails safely to the ground and produces a most brilliant display in the process and for some time after landing.

Altitude Indicators

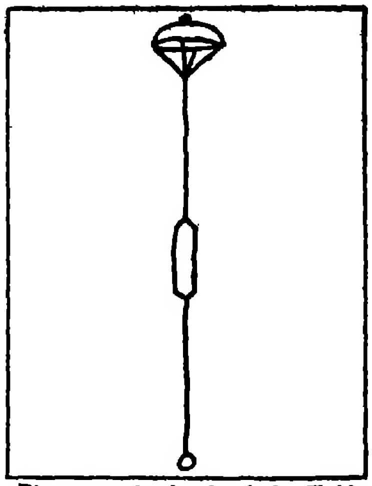
THE airplane altimeter is nothing more than a small, accurate barometer which registers the pressure of the air. A certain pressure is taken as corresponding to a certain altitude, based on standard atmospheric conditions. But weather conditions and temperature changes influence the pressure drop at altitude to such an extent that the altimeter can never indicate the exact height above the ground or sea level. Not infrequently the altimeter may tell the pilot that he is flying below the ground!

The errors involved are not so important for an airplane flying at several thousand feet above the ground But if a plane is operating in a fog or at night, the pilot may be flying his machine dangerously low without his instrument giving him sufficient warning for safety

Another principle than that of pressure indication has to be employed. The German physicist Behm has now developed an altitude indicator based on the principle of the speed of echoing sound, in a form entirely suitable for use aboard an airplane. When the sounding signal is given, a point of light is set in motion parallel to a vertical scale by a combination of electrical and acoustic appliances. When the echo reaches the sounder, the point of light immediately descends to its zero position The vertical scale is graduated up to 200 feet, and the motion of the point of light accurately gages the altitude to within a few inches. The Behm sounder once set to work, can also operate automatically and give a reading at intervals of half-a-second The instrument should prove invaluable in all cross-country flying

For airship navigation it may also be important to know the exact height several thousand feet above sea level Only thus can the navigator interpret his altimeter pressure readings for meteorological purposes. Here the sound indicator becomes less useful, and at great heights the conflicting sounds always present on board an airship may cause it to become inoperative

A correspondent of the Scientific American, Elbert N Todd of Crisfield Maryland, has been working along entirely different lines. A very small radio transmitter with its batteries is enclosed in a suitable vessel An aerial wire from the transmitter in the vessel is suspended by a small parachute three to four inches in diameter The ground wire hangs below the vessel and has



Diagrammatic sketch of the Todd altitude indicator. A small vessel incloses a wireless transmitter which gives a signal when the ground is struck. The size of parachute allows the speed to be regulated

a small weight on its end to keep it taut. The device is dropped from the airship by a radio operator and can be made to fall at any given speed by suitably adjusting the weight of the apparatus and the size of the parachute.

When the sounder strikes the earth or sea, a spring contact arm, held out of engagement by the pull of the weight on the end of the ground wire, is relieved of this weight and closes a circuit. The radio signal sent out is picked up by a suitable receiver and aerial on board the airship, and from the time intervening between the dropping of the vessel and the receipt of the signal, the height is calculated

While certain errors are possible, such as varying velocity of fall due to a possible vertical movement of the intervening air, the idea is worth serious consideration and is certainly ingenious.

Educating the Schoolboy

THE British are thorough believers in the popularization of flying. Subsidized light airplane clubs, popular lectures in schools and other methods are employed to this end Our photograph is evidence of this policy The master of Sempill recently completed a thousand mile tour of the British Isles in a De Havilland *Moth*, a most successful light plane, and is seen demonstrating the craft to a group of typical English boys at the Schoolboys' Exhibition in London

London News Agency

The master of Sempill, an English school, recently completed a thousand-mile tour of the British Isles in a De Haviland *Moth* light airplane. He is seen demonstrating with a *Moth* at a schoolboys' exhibition held in London

Acme

Officer looking through the eyepiece of a speed and drift indicator

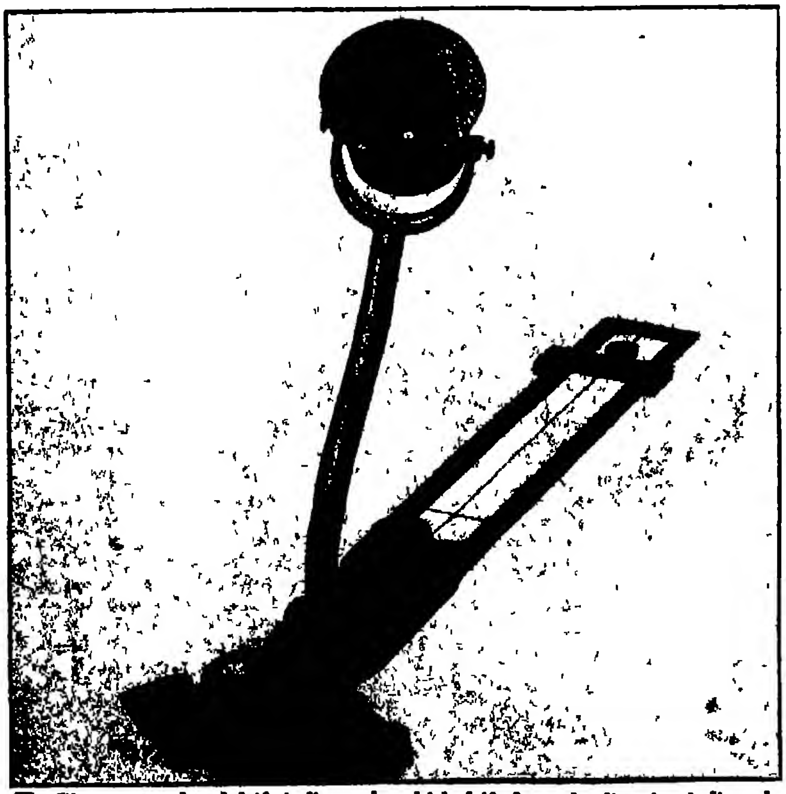
A Speed and Drift Indicator

IN a recent flight from Dayton, Ohio, to Boston, Massachusetts, Captain Bradley Jones and Lieutenant Lyman P. Whitten of the Army Air Service flew 725 miles in 350 minutes, breaking the non-stop record between these two cities. The primary object of the flight was not to break records, however, but to test a number of instruments, such as a turn indicator, an earth inductor compass and a speed and drift indicator With these instruments cross-country navigation becomes possible even in fog or in the dark. Through the courtesy of the Pioneer Instrument Company we are able to describe in detail the latest and simplest form of the speed and drift indicator

The base plate is mounted on the side of the airplane. Suppose that the airplane is not traveling in the direction of its longitudinal axis, but owing to a side wind is drifting sidewise. The navigator is anxious to determine the angle of drift. He rotates the vane of the instrument by the knurled disk with a short handle until objects on the earth or sea appear to travel along the longitudinal drift wire He has then determined the angle of drift.

This is not sufficient for purposes of navigation however The pilot must know the true speed over earth or sea The air-speed indicator is a measure of the speed relative to the surrounding air, but if the air is itself in motion, that is if there is a wind, the air speed is *not* the true speed To determine the true speed, the slider is moved along the vane until the movable cross-wire is at a figure corresponding to the altitude Looking through the eye-piece, the distance seen on the ground between the two cross-wires is read on the side of the vane This is a matter of geometry, with the markings based on simple calculations made at the time of the construction of the instrument With a stop watch the time taken between two sighted points is accurately determined, and with a table furnished with the instrument, the true speed is at once obtained

A pilot can learn the use of this speed and drift indicator in a few minutes, and he never disregards it afterwards. There is but one error involved and that is in the altitude, since the altimeter gives an altitude based on the pressure of the air, and this may vary with atmospheric conditions. But this error does not vitiate the general value of the method.

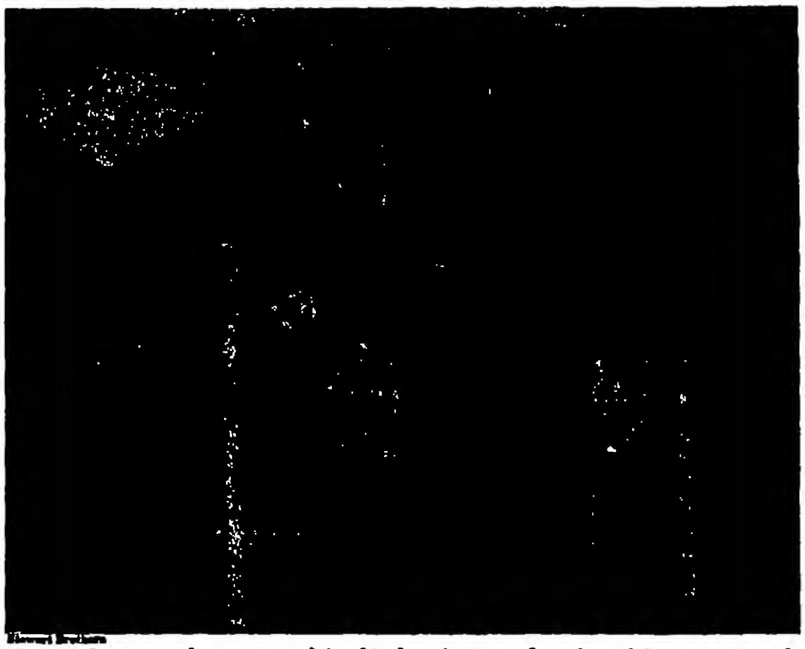


The Pioneer speed and drift indicator by which drift from the direction indicated by the nose of the plane, and the true speed over the earth can be measured

Radio Notes

A Review and Commentary on the Progress in This Branch of Rapid Communication

Conducted by Orrin E. Dunlap, Jr.



Stewart Brothers

A six-tube neutrodyne set used in this location was found to deliver very good results. In a cave at Manitou, Colorado, 7,500 feet above sea level, using one hundred feet of wire for an aerial, stations 1,000 miles away were received

Latest Development in Power Amplifiers

A NEW development in the field of power amplification for radio reception has been introduced by the Pacent Electric Company. The device is known as a "powerformer" and in addition to supplying tremendous amplification it operates in connection with the 110-volt, 60-cycle house lighting mains and eliminates the necessity for "B" batteries. The engineers have succeeded in eliminating the hum caused by the alternating current and there is no fluctuation in signal strength even with a variation in voltage of 10 percent either way. Likewise the frequency can vary five percent either way of the standard 60-cycle frequency.

The powerformer can be used with any receiver equipped with at least one stage of audio-frequency amplification in which case the new instrument serves as the second stage of amplification as well as the "B" battery supply.

The device does not make it possible to dispense with "A" batteries, used with the radio set, but the powerformer furnishes its own filament current and all the "B" battery voltage.

The instrument measures 8 by 8 by 10 inches and weighs 32 pounds. A metal cabinet houses the transformers, choke coils, filter condensers, tubes and wiring. At the rear of the case there is a recessed panel, with the binding posts for the various "B" voltages for the detector, radio and audio amplifier tubes and a ground connection.

The front of the cabinet has a hinged drop door which can be lowered to a 45-degree angle, giving ready access to the unit's tubes. A red pilot lamp just below the door indicates whether the powerformer is "on" or "off." There are no adjustments to make except the snapping of the control switch on or off, and there are no parts that wear out except the two tubes and the pilot lamp. The tubes consist of one UX 216-B or a CX-316-B rectifier and one UX-210 or a CX-310 power amplifier.

Great volume is obtained from the powerformer, if desired. In fact with normal signals the radio-frequency amplifiers and detector of the receiver are turned down to a dim glow and whatever volume control is desired is accomplished by the rheostats regulating the current supply to the filaments of the tubes in the receiving set. In the case of a regenerative set the regenerative or tickler control acts as a handy volume regulator. On local reception the powerformer may be used in conjunction with only the detector to give sufficient volume for a large size room.

The advantages of the device are tremendous volume from two-tube sets with minimum distortion, elimination of "B" batteries, clear and loud amplification from all receivers.

RCA Take License for Cone Speaker

IT has been announced by the Lektophone Corporation of Jersey City, New Jersey, that the Radio Corporation of America has purchased a perpetual license to use the Lektophone patents in the manufacture of cone type loudspeakers for a cash payment of $200,000. The Lektophone Corporation owns the basic patent of the cone type speaker issued to Hopkins and Farrand.

C. L. Farrand is the inventor of the cone and his patents date back to 1918. The original patents for the diaphragm reproducer were filed in 1913 by Marcus C. Hopkins, for use in phonographs. Five years later Mr. Farrand perfected the device for radio purposes.

Interchangeable Coils for Short Waves

INTEREST among radio fans in reception of short wavelength stations has stimulated several manufacturers to introduce interchangeable coils. These inductances are designed so that they can be quickly plugged into a socket similar to the way vacuum tubes are inserted in sockets.

One designer offers a set of flexible coils, which require three standard vacuum tube sockets installed in the circuit, to tune in all wavelengths from 30 to 2,000 meters. The coils range from 30 to 109 meters; 40 to 180 meters; 109 to 300 meters; 324 to 555 meters, and 555 to 2,000 meters.

The coils of another manufacturer receive from 50 to 1,800 meters. These inductances

require a special six-contact socket so keyed that a coil cannot be inserted incorrectly.

The third manufacturer has developed a short-wave interchangeable coil system which can be mounted readily on the radio fan's present broadcast receiver It consists of three coils, each unit comprising a grid and plate inductance A suitable base is provided on which is mounted an adjustable primary coil, the coupling of which may be set for best results with long or short antenna. The coils are mounted on bakelite strips. The windings are bare copper

Swiss Have Trouble from Power Lines

SINCE the war, Switzerland has practically completed the electrification of its railway system. Nearly every town of any size has its electric tramways and most houses have electric light. The water power resources are being developed rapidly and current at voltages up to 60,000 is now carried over considerable mileage by overhead cables. The network of wires caused so much induction that it was found necessary to bury all telephone trunk lines and now the interference from the high power lines, electric railways and tramways is causing great interference for broadcast listeners. Another adverse condition radio has to contend with in Switzerland lies in the topography of the country High mountains and deep narrow valleys dot Switzerland with "dead" spots. Despite these drawbacks, however, the Swiss are forging ahead with their broadcasting system Three stations are now in operation and two more are planned. It is reported that vacuum tube receivers are rare, but crystal sets can be counted by the thousands, especially in Zurich and Geneva, centres of broadcasting. The Zurich transmitter is said to be one of the finest in Europe.

How to Prevent Motor Interference

THE Canadian Research Council recently completed an investigation relative to the causes of interfering noises in radio sets and suggestions for their elimination have been compiled for broadcast listeners.

A series commutator motor causing a surge by sparking at the brushes may have its leads reversed to reduce the interference it creates for near-by listeners. Where one wire is grounded, interference from such a motor is sometimes eliminated by reversing the leads supplying the motor, so that one of the brushes is connected to the ground side of the line and the field coil is connected to the live side of the line In this case, the field coil is used as a choke. It may also be necessary to place a condenser of one or two microfarads' capacity across the brushes.

In cases where neither side of the line is grounded, a choke may be inserted on the line connected directly to one of the brushes, while the field coil may act as a choke on the other line. In this case, it is recommended to use two two-microfarad condensers in series and ground the middle point.

In cases where it is not convenient to make connections with the brushes of a motor, the condenser may be placed across the line as near the motor as possible, and a choke coil may be inserted in the live line when necessary The live side of a low voltage lighting circuit may be determined by means of a test lamp connected from the ground, first from one wire and then to the other The lamp will light when connected from the live line to the ground.

Metal and Parchment Used in Diaphragm

DR. Herman Fisher, acoustical engineer of the Tower Manufacturing Company, recently introduced a new loud speaker diaphragm built on the principle of a violin

In his study of the violin he learned that the solid backpiece of the instrument varies in thickness throughout its area. It is thicker in the centre and directly opposite the bridge than it is at the edges. The back piece of a violin, according to Dr Fisher, is shaped by expert hands, men who become artists in giving the wood the proper graduations, and from its thickest point in the center, it tapers off until, at the edge, its thickness is reduced by more than one-half

The principle underlying this practice is that a thicker wood will vibrate more slowly

Kadel & Herbert

This device for recording radio music and speech in permanent form for future reference or for record has recently been devised by Francis R. Hoyt whose radio inventions and writings are well known to the radio public

The antenna lead-in and the tuning inductances of the Rugby, England, high power radio transmitting station can be seen above. The inductances are wound on wooden arms and are adjustable in their relationship to each other for tuning

than thin wood, and when the backpiece is of different thicknesses the perfect vibration of all tones is achieved The thick part of the wood, vibrating slowly, brings out the low violin tones to their fullest and richest extent, while the thinner surface throws back the higher tones, with nothing lost in the recording This result illustrates the fact that the backpiece of the violin is the part that in reality registers violin tones—not the top piece, nor the bridge nor the strings themselves It is on this principle employed in the construction of the backpiece of a violin that Dr Fisher has modeled the new diaphragm It is of different thicknesses, being thicker in the centre and thinner toward the edges.

The new diaphragm is made of parchment and metal. The thin parchment records the high tones and the metal, the low tones. The parchment-metal combination is thick in the center and thinner at the sides, designed to give proper balance to high and low tones.

Plan of 1842 Still Good

TRANSMISSION of pictures by radio is based upon a discovery made by Alexander Bain, an English Physicist, in 1842 according to Captain R H. Ranger, inventor of the transatlantic photo-radio system

Captain Ranger pointed out in the Proceedings of the Institute of Radio Engineers that Bain first proposed a device to send pictures from one place to another by electric wires. He said, "Bain's plan is so basically correct that it is only right to mention it and to show how generally we are following in his footsteps."

Bain had two pendulums, which were arranged electrically in such a manner that if one preceded the other by a slight amount of the time of a stroke it was held until the other had reached the same position, when both then began a new stroke. These swinging pendulums were the basic synchronizers which are necessary in the transmission of pictures by wire or radio

On each swing of the pendulums, a tablet descended a notch at a time at the side of the pendulum At the transmitting station the swinging arc of the pendulum carried a small contactor which rode over the type faces, making the appropriate electric contacts to be sent to the distant receiver where a similar swinging pendulum was tracing the path across a piece of paper By chemical action, the electricity received from the transmitter would discolor the paper to give an impression of the original

Captain Ranger explained that these are the basic elements of all radio pictures. First, the synchronous action covering a surface point by point at both transmitter and receiver and second the electrical identification of the points traced out at the receiver

Under 50 Meters

SHORT-WAVE stations are increasing in number as are the owners of receivers designed to pick up the waves traveling through space below the 100-meter channel. The following list of transmitters operating on waves less than 50 meters has been compiled for their convenience

Call	Location.	KC.	Meters.
POF	Nauen, Germany	22209	13.5
2XS	Rocky Point, N Y	20082	14.93
2XAW	Schenectady, N Y	19988	15
2BR .	Chelmsford, Eng.	19988	15
POF	Nauen, Germany	18738	16
NKF	Anacostia, D C.	18738	16
2BR .	Chelmsford, Eng.	17636	17
POF .	Nauen, Germany	16657	18
2XAD	Schenectady, N Y	14991	20
KFVM	S. S. Idalia ..	14991	20
POF .	Nauen, Germany .	14991	20
NAL	Washington, D C.	.14991	20
NEPQ	U S S. Relief. .	14991	20
NKF	Anacostia, D C. .	14414	20.8
WIK	N Brunswick, N J .	13628	22
2YT	Poldhu, England	11998	25
POY	Nauen, Germany .	11998	25
FW.	Ste. Assise, France	11998	25
NKF	Anacostia, D C. .	11758	25.5
AGA	Nauen, Germany .	11532	26
PCMM	Kootwijck, Holland..	10908	27.5
POW	Nauen, Germany .	10708	28
2XI	Schenectady, N Y .	9994	30
NAL.	Washington, D C... .	9798	30.6
2YT ..	Poldhu, England . ..	9369	32
ANE .	Malabar, Java ...	9369	32
NAJ .	Great Lakes, Ill. .	8690	34
WQO	Rocky Point, N Y. ..	8560	35.03
PCMM	Kootwijck, Holland. ..	8328	36
PCUU .	Kootwijck, Holland..	7890	38
KFVM	S. S. Idalia	7496	40
NAS. .	Pensacola, Fla.	7496	40
NAJ	Great Lakes, Ill	7496	40
NPG.	San Francisco, Cal....	7496	40
NRRL	U S. S. Seattle. . .	7496	40
NQW	U. S. S. New Mexico.	7496	40
2XAC .	Schenectady, N Y... .	7496	40
NKF ..	Anacostia, D. C.......	7260	41.3
2XAF ..	WGY, Schenectady....	7160	41.88
5XH...	New Orleans, La., ...	7139	42
FW...,	Ste. Assise, France...	7139	42
WIZ. .	N Brunswick, N. J . ..	6970	43.02
WQO	Rocky Point, N. Y....	6814	44
KZA.	Los Angeles, Cal.. ..	6814	44
KZB	Los Angeles, Cal	6814	44
PCLL .	Kootwijck, Holland .	6518	46
WHD	Sharon, Pa.	6119	49
NPM	Honolulu, H. T .	6119	49
2XAD .	Schenectady, N. Y.. .	5996	50
SAJ..	Karlsborg, Sweden.	5996	50

New York to See Two Radio Shows

Two radio shows are scheduled to be held in New York the week of September 10-17; the Radio World's Fair at Madison Square Garden and the National Radio Exposition at the Grand Central Palace. It is the opinion in radio circles that this will be the last year to witness two radio shows staged in New York at the same time

The National Radio Exposition Corporation organized by leading manufacturers for the purpose of conducting radio shows issued the following statement to its stockholders: "It is generally agreed that the holding in certain cities of competing shows by rival promoters is a serious burden on the industry This situation is particularly acute in New York, where for several years competing shows have been held. The directors are confident that after this year there will be only one radio show in New York."

Protective Rules for Radio Sets

THE National Board of Fire Underwriters has a set of rules for the installation of radio antennas and protective devices.

The regulations stipulate that the lead in wire must be of copper, approved copper clad steel or other metal, which will not corrode excessively, and in no case shall the wire be smaller than No. 14 B & S gage, except that bronze or copper-clad steel not less than No. 17 in size may be used

"Each lead in conductor shall enter the building through a non-combustible non absorptive, insulating bushing slanting upward toward the inside, or by means of an approved device designed to give equivalent protection.

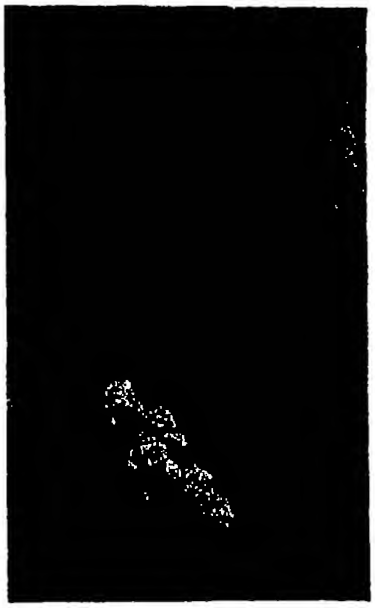
"Each lead-in shall be provided with an approved protective device (lightning arrester) which will operate at a voltage of 500 volts or less, properly connected and located either inside the building or at some point between the entrance and the receiver which is convenient to a ground, or outside the building as near as practicable to the point of entrance. The protector shall not be placed in the vicinity of easily ignitable stuff, or where exposed to inflammable gases, dust or flyings of combustible materials."

The ground wire may be bare copper, bronze or approved copper-clad steel and should not be smaller than No 14. The ground wire running from the lightning arrester to the earth should run in as straight a line as possible to a good permanent ground.

Preference is given in the rules to the cold water pipe. Other permissible grounds are grounded steel frames of buildings or other grounded metal work in the buildings,

Wide World

David Loewe is here shown demonstrating a new vacuum tube developed by his brother, Dr. Sigmund Loewe, a German inventor



International

This view was taken from one of the masts of the Rugby station and shows the aerial insulators and the cage aerial

and artificial grounds such as driven pipes, rods and plates. Gas pipes should never be used for radio earth contacts.

The protective ground wire should be guarded where exposed to mechanical injury, and an approved ground clamp should be used where the ground wire is connected to pipes.

The rules state that the protective ground wire may be run either inside or outside the building but wires inside the building must be securely fastened and should not come nearer than two inches to an electric light or power wire not in conduit unless separated therefrom by some continuous and firmly fixed non-conductor, such as porcelain tubes or approved flexible tubing making a permanent separation This non conductor shall be in addition to any regular insulation covering the wire

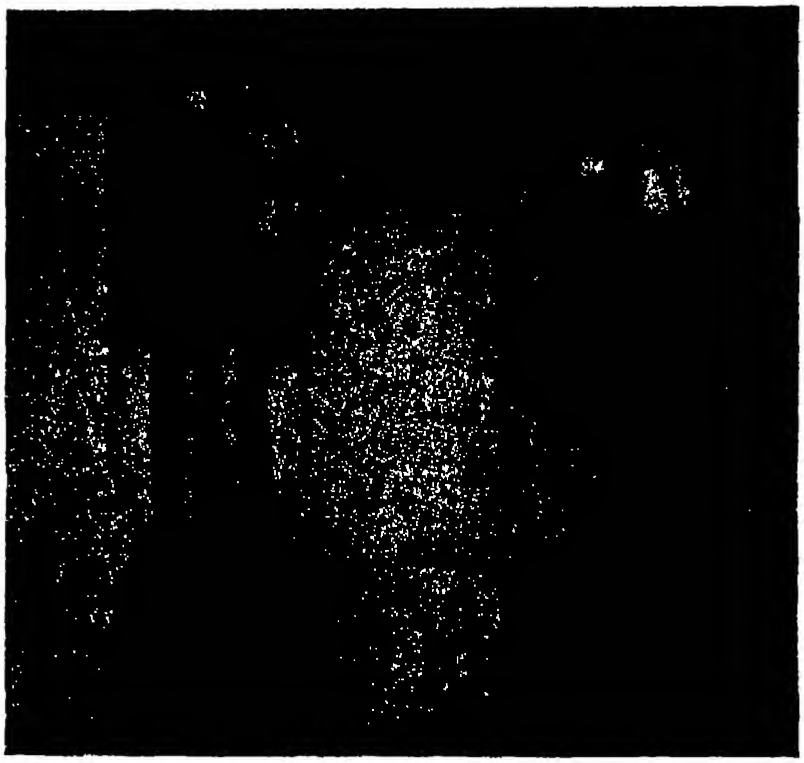
The function of a lightning arrester is to drain the accumulated static charges off the antenna and according to the rules the atmospheric electricity may be led down to the earth through the cold water pipe or radiator inside the house However, it is recommended that the lightning arrester be placed outside the house so that the ground wire from the arrester will run in a straight line to an earth connection outside the house. A pipe driven in the earth can be used as this ground

German Tubes Differ from American

A NEW type of vacuum tube has been invented by Dr Sigmund Loewe of Germany The underlying basic element of the new multiple tube is a resistance sealed in an evacuated glass tube The resistances consist of glass rods with welded connections on the surface of which there is deposited a fine metallic compound film, which serves as the resisting element It is all enclosed in a highly evacuated glass tube This resistance is said to be positively free of capacity and therefore will not retain any electrical charge The resistance remains constant and will not vary with temperature

The multiple radio frequency tube contains two or three grid units and it is contended that this has made it possible to overcome the difficulties of resistance coupled radio-frequency amplification together with the fact that the tube uses a double grid system having a very low internal ohmic resistance Furthermore, on account of the fact that the units are located so closely together, the leads are very short, thereby reducing the capacity effects.

Inside the main tube there is also a smaller tube containing a mica coupling condenser so that gases from the mica cannot destroy the vacuum of the main tube.



Two different forms of the newly devised multiple radio vacuum tubes are shown above. The tubes comprise complete detecting and amplifying circuits

The large tube is one glass bulb with four smaller bulbs encased

It is contended that the audio frequency tube will permit a voltage amplification more than 1,500 times on frequencies between 50 and 10,000 The one tube contains a radio-frequency amplifier, detector and one power amplifier combined Selectivity of the circuit in which the tubes are employed, high amplification and a guaranteed life of 1,000 hours are the features of the tubes. They are not on the American market but it is understood that an American company may be granted a license to manufacture the tubes in the United States.

Voltmeter to Test "A" and "B" Batteries

A DIRECT current voltmeter, a portable instrument, designed especially for use with radio receiving sets and known as type DO-3, has been introduced by the General Electric Company The instrument has a double scale, zero to 7.5 and zero to 150 volts, which combinations are most suited for measuring filament and plate voltages ("A" and "B" batteries)

Each instrument is equipped with a set of 18 inch leads with terminals and the device can be mounted on the panel of the receiver or used portably It will probably be more useful as a portable instrument

Weather and Radio

INVESTIGATIONS of radio wave propagation by engineers at WGY show that the signals are better 600 miles from the transmitter than they are at 300 miles. It was found that signal strength drops off rapidly during the first 300 miles but is stronger at a receiver 600 miles distant Beyond the 600-mile limit the signal strength gradually weakens. The engineers explained that these distances are not definite values but averages from a large number of reception reports.

A study of the zones in which fading occurs shows that it is worst between 200 and 500 miles from the transmitting station. Therefore, broadcast service is more reliable at 600 miles than at 300 miles because fading is less and the volume is slightly increased. Reception reports indicate that the rate of fading increases steadily as the wave-length grows shorter

Furthermore, the investigations indicate that the relationship of barometer pressure and temperature with radio conditions is not definite, or if it is definite, that it is so complex that it is not yet understood Temperature seems to have no effect upon the signals, although static increases as the temperature rises, especially in summer

The barometer pressure seems to make little difference in signal strength when both transmitter and receiver are at the same pressure When transmission is from a high to a low pressure area, transmission is best at short and at long distances, but at a medium distance of 600 miles it is best from an area of low to an area of high pressure

Latest Power Tube

THE UX 171 has been introduced as a new power tube for use in the last audio stage of storage battery operated receivers. The filament current is controlled by a 5 or 6 ohm rheostat and can be operated from a 5-volt alternating current supply The maximum plate potential is 180 volts, negative grid bias or "C" battery should be 40.5 volts for the full 180 volt "B" battery The approximate plate current in milliamperes is 20

The output from this tube is so powerful that it is imperative that a transformer or choke and condenser be placed between the tube and loudspeaker It is recommended that the plate current be delivered through an audio frequency choke of from 10 to 30 henries. A 2 to 6 microfarad condenser is then connected in one lead of the loudspeaker and the other loudspeaker lead goes to the "B" battery side of the choke If preferred the output may be delivered to the primary of a 1 to 1 output transformer, the secondary of which is connected to the loudspeaker In either event the direct current from the tube will not flow through the loudspeaker The function of the transformer is to insulate the loud speaker from the high voltage used in the plate circuit Only the desirable alternating current component will be passed to operate the loudspeaker This tube has the new standard UX base

UX-200-A Is Latest Detector

THE UX-200-A is a new and more sensitive detector tube developed by the Radio Corporation of America It operates in connection with a six volt storage battery and a "B" battery of 45 volts. The filament current is .25 amperes and the plate impedance is rated at 28,800 ohms. A ten

.00025 mfd. grid condenser are recommended for use with this tube. It is of the same general design as the UX 201 A.

Eavesdropping on the Brain

Dr. E. D. Adrian, of Cambridge University in a paper read before the Physiological Society in England suggested the possibility of eavesdropping on the human brain by means of radio instruments, in which vacuum tube amplifiers play an important part.

Dr Adrian said that he believed that within the next few years it should be possible to read the main types of brain messages passing down from the brain via the nerves to the muscles. The passing of the messages down the nerves seems to cause an electrical disturbance and Dr Adrian's apparatus records on a rapidly moving photographic plate the impulses along a single fibre He "decodes" the nerve impulse by segregating a single fibre of the system

It was pointed out that the sense organs in the skin which register temperature, touch and pain are too close together for easy segregation but the fibres in the muscles are farther apart and can be used as a link between the brain and the radio recorder

New Traffic Manager

F E. Handy of Augusta, Maine, is now Traffic Manager of the American Radio Relay League, having succeeded F H Schnell, who resigned to pursue an experimental career

Composers Say Radio Reduces Royalties

Toll broadcasting, sponsored by advertisers, has not reached a paying basis, according to W E. Harkness, an official of WEAF, in a statement made at the hearings on the radio bills before Congress. He said that the American Telephone & Telegraph Company hoped to show a profit from broadcasting this year

During his talk Mr Harkness said that the broadcasting of a certain play in New York increased the box office sale by 3,000 tickets. John McCormack singing over the radio brought in 60,000 orders for a single record and a WEAF client received 500,000 letters from listeners in connection with a popular radio feature.

Gene Buck, President of the Society of Authors, Composers and Publishers said that radio had caused the sale of sheet music to drop fifty percent

John Philip Sousa said that his royalties had been greatly reduced because of radio His first published work attained a maximum monthly income of $60 000 in royalties before the days of the phonograph and radio but in 1925 his income from royalties dwindled to $29,500 The bandmaster blamed radio for the reduction

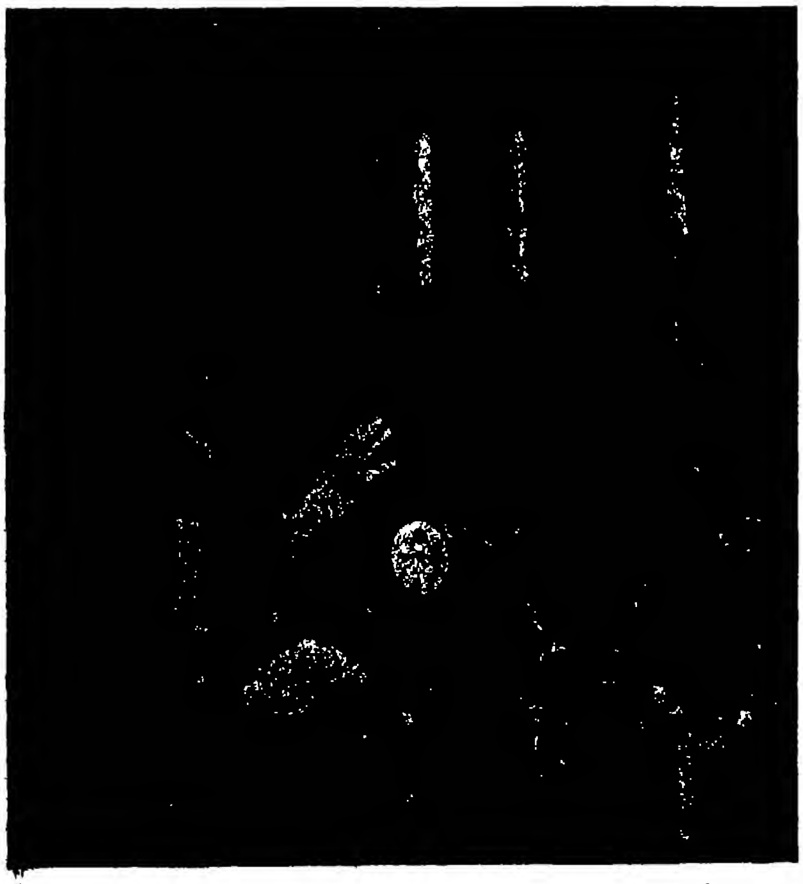
Neutrodyne Patent

A patent covering an arrangement for eliminating magnetic coupling between any number of coils in an electric circuit by mounting the coils at a specific angle with respect to each other has been issued to Professor L. A Hazeltine by the United States Patent Office The number of the patent is 1,577,421 and is the fourth in the series covering the Hazeltine neutrodyne inventions Ten claims are allowed in the patent

Cone Equipped with Soundboard

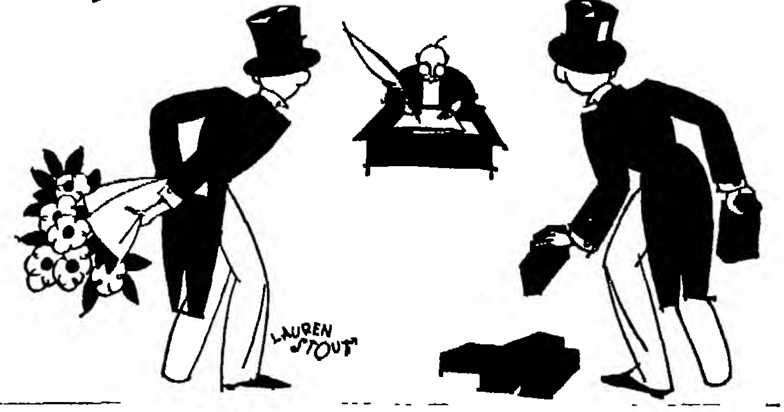
A cone type loudspeaker equipped with a soundboard has been introduced by the Stromberg-Carlson Telephone and Manufacturing Company The soundboard is in the form of a wide wooden ring upon the inner edge of which the cone is built The engineers contend that the wooden ring is designed especially for vibrating at audible frequencies and therefore adds a fullness and timbre to the lower notes The instrument is made in the form of a tip-top table, the cone and soundboard imitating the top surface when in the horizontal position. The speaker is mounted on a pedestal with legs.

An extra long cord, twenty feet in length enables the use of the loudspeaker some distance from the receiver



The S. S. Hamburg is now equipped with the latest type of vacuum tube transmitting apparatus. With it, it is possible to maintain long distance communication, either by means of C. W. or radiophone. Note the foreign vacuum tubes

IN THE EDITOR'S MAIL



Creation?

In the May issue of the Scientific American, page 310, Professor William D MacMillan of the Department of Astronomy, University of Chicago, published an article entitled "The New Cosmology," in which he outlined a great cosmological cycle Stars radiate their energy away into space, he believes, and this energy evolves elsewhere into atoms, new stars are thus ultimately formed The significance of the MacMillan cycle, if its truth can be established, would be that the universe is not, after all, running down to cold extinction, as many cosmologists believe.

Dr J A McWilliams, Professor of Cosmology at St Louis University (St Louis, Mo) comments on Professor MacMillan's article in a letter, which we subjoin, together with the reply of Professor MacMillan

Editor Scientific American,
Dear Sir

"The New Cosmology" by Professor MacMillan in your May number, must surely have aroused comment Speculations about how the world may reconstitute its available energy are always fascinating, and Professor MacMillan makes out an interesting case for his theory For some time past the transformation of ponderable matter into energizing ether, though scarcely supported by any direct evidence as to the fact, has proved to be one of those conjectures that captivate the mind. Professor MacMillan takes the next step, he postulates the reconversion of energizing ether back into ponderable bodies, even into highly organized atoms.

My personal reaction to all this is, that although it is conceivable that a world may be a perpetual motion machine, there do not appear to be any reliable indications that this particular world is such. The basis of Professor MacMillan's theory seems to be that "Atoms are certainly being evolved somewhere." The "somewhere" is not important. But to say that they are *certainly* being reconstituted is asking us to go rather far with him in his enthusiasm for his theory The readers of the Scientific American would, I believe, be interested in having the data that atoms are reconstituted anywhere.

Certainly it should be a great discovery if the world were shown to be continually restoring itself in cycle after cycle But what the Professor has in mind by his allusions to creation, I confess I cannot see Surely he cannot mean that the conversion of ether into atoms is a case of outright creation. And his rendition of what our grandfathers held about the six days required for the genesis of the world is hardly *a propos*, for St. Augustin considerably antedated our grandfathers, and he with many others of his time allowed indefinite eons for the formation of the world.

I do not contend that Professor MacMillan's theory is impossible of verification Its verification would be only a greater manifestation of the intricate and stupendous way in which the world is designed to carry on But that its verification would make original creation and designing unnecessary, is impossible to see. The extension of the world's existence over countless eons does not in the least affect the evidence of creation, and reinforces that of design I do not mean that Professor MacMillan infers the contrary conclusion Purely physical science, as he rightly says, has no way of dealing with creation Physical science starts with the world as a datum, without going into the antecedents of the very material world itself However, his allusions to creation may, I fear, mislead an unwary reader as to their import and are thus my excuse for offering for your "Editor's Mail" these few comments.

Sincerely yours,
J. A. McWilliams,
Professor of Cosmology

Professor MacMillan's reply to the letter printed above follows

Editor Scientific American,
Dear Sir

If Professor McWilliams will be good enough to refer to my paper in the *Astrophysical Journal* of July, 1918, he will find that the idea of the regeneration of matter was not the "next" step, as he calls it, but was the first step in the sequence of my ideas, the idea of the degeneration of matter, as a matter of fact, was the second step. The second step has received more publicity than the first, owing to the relatively recent conversion to it of Jeans, Sir Oliver Lodge and others. In my opinion the two ideas should not be separated, but should stand or fall together

As for the remainder of his letter, it is a pleasure to recognize his philosophical attitude. Every intellectual structure, cosmologies in particular, rests upon a system of postulates which are not matters of evidence. I have laid considerable stress upon this point in previous publications (see, for example, *Science*, August 7, 1925), and I should like to repeat that there is nothing compelling in any postulate. Only those who choose to adopt a postulate are bound by it, others are free to make another choice, or, if they are like the majority of people, they may refuse to consider the matter altogether

The statement that "atoms are certainly being evolved somewhere" rests upon the postulate that *the universe does not change always in any one direction*. Assuming, as I have done, that atomic degeneration is the source of the stellar energies, then, in accordance with this postulate, regeneration is certainly going on somewhere. If one does not choose to accept the postulate the conclusion disappears of its own accord

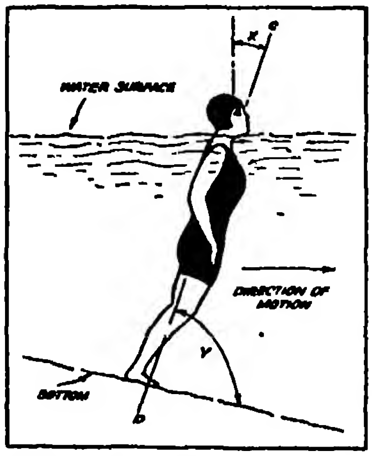
As to his references to creation, it seems to me that Professor McWilliams is connecting together statements that are rather far apart in my article. My allusion to our grandfathers and our fathers in my introduction was merely for the purpose of sketching hastily the flow of ideas in relatively recent times with respect to cosmology. Certainly many of the ancient philosophers and the early church fathers had very lofty

ideas on these matters, but they lay outside of the picture which I was sketching. On the philosophical side the question of creation is covered by the postulate that *the physical universe is continuous in time*. This postulate excludes the notion of creation, for the moment of creation would be a discontinuity. I believe that almost all scientists more or less consciously adopt this postulate. It is certainly one of the postulates of the doctrine of evolution.

As for the doctrine of design, I have no postulate which covers that point, and I cannot see any object to be achieved in making one. However, I am entirely in sympathy with any one who is interested in making a definite system of postulates. All that I ask is that he be careful that his postulates do not contradict one another.

There is nothing *a priori* that distinguishes any one system above all others.

Yours very truly,
W. D. MacMillan.



Compare the indicated angles in the above drawing with those in the illustration in the next column

More on the Subject of the Undertow

In the Scientific American Digest of last August there appeared an abstract of an article written by the noted physiographer, Prof. W. M. Davis, of Harvard, in which he undertook to demonstrate that the steady undertow of the ocean beach is a myth. Many of our readers now refuse to take the Professor's statements lying down. They say, in effect, "The undertow may be explained away—theoretically, but we have been in it, felt it, nearly lost our lives on account of it." Is this no-undertow theory to be exploded by a mere fact? Here is what one of Prof. Davis's opponents—name omitted by request—has to say about the undertow:

Editor, Scientific American:

To your discussions of undertow, will you permit me to add my own observations and deductions?

I am an expert swimmer and have swum much in the ocean at various Atlantic beaches and frequently during storms at Virginia Beach, Virginia, when the undertow was strongest.

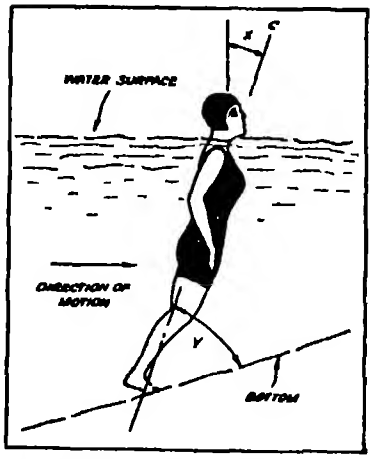
To non-swimmers the undertow frequently means a swift current *along* the beach, which tends to sweep them off their feet. This is obviously not the subject under discussion, but is mentioned here only to draw the distinction between that and the outwardly flowing current of the true undertow.

I am familiar with the theoretical circular or elliptical motion of the particles in a wave *before it breaks*, but after it breaks, a volume of water is thrown forward above the surface before it, and travels toward shore. Any swimmer can tell you the difference between the impact of the broken wave and the gentle lift of the unbroken swell, and the rush of the wave coming onto the beach will attest the movement of water shoreward, as each wave (after breaking) foams toward shore above a layer of comparatively quiet water. Incidentally, in shallow water, the incoming swirl of the wave draws with it, for a few inches, all be seen by the sand shifted from the ripples on the normal sand bottom. Probably this is due chiefly to friction.

The incoming waves, having traveled in, roughly speaking, on top of the water, the water runs up on the beach slope, recedes, following the slope until below the water level, and *then travels outward below incoming breakers*. When swimming in rough water, I always take advantage of this when going seaward, by swimming with my feet well down, and diving deeply under incoming waves, but when swimming toward shore, it is far easier to swim flat on the surface and let the incoming waves help one ashore. I have never experienced a continuous outward current (though nearly so) as each incoming wave momentarily drags back the water below it.

The undertow seems to be greater as the slope of the beach increases, or as the surf becomes more heavy. In the first case, the return flow from the beach starts with greater velocity, but is soon slowed down in the deeper water and is not troublesome, in the second, the return-flow is of greater volume, and can cause a considerable current.

There is another factor that affects the non-swimmer on a sloping bottom, that thus far seems to have been entirely overlooked. It has nothing to do with current, but to those unfamiliar with the water, it might be mistaken for an adverse current or undertow. It is the difficulty of walking up a slope with the body nearly submerged. The weight (that is, the pressure between the feet and the bottom) of any one submerged above the armpits is very slight, owing to the displacement of the submerged portion, consequently, it is harder to get a foothold because the friction of the feet on the bottom is less. At the same time, much greater force than usual is needed to move the body forward against the resistance of the water, and the body must be leaned far forward before any progress can be made. In other words, the thrust which the bather must exert against the bottom is inclined at an angle to the vertical, called "X." In climbing up a slope, the angle "Y" is small, compared to the angle "Y" in descending, and with the small friction existing, the feet get a very poor grip. In fact, it is very hard to climb a slope when nearly submerged, but very easy



The difficulties of ascending a slope in the water may explain the sensation of an undertow

to descend. This may be tested by walking as far as possible down the sloping floor of any swimming pool, and then trying to walk back.

The Anti-Aircraft Question

Believing that the article on anti-aircraft artillery may have given rise to some questions in the minds of other readers, similar to those which occurred to Lieutenant Gardiner H. Fiske, we are passing along the additional information from Colonel Cloke received in connection with the following letter:

Editor Scientific American:

I have read Colonel Cloke's article

made in fire control of anti-aircraft guns, which is of interest, but seems to be based on several false premises.

In the first place, the assumption is made that the target (enemy aircraft) is to travel "in a straight line, at constant speed and at uniform altitude" during "the period of time included in the time it takes to load the gun and the time of flight of the projectile." During the period September-October, 1918 our pilots and observers in bombardment squadrons were instructed to continuously change their altitude or direction when over the enemy's lines. This was usually done by a "skidding" to the right or left "peaking down" slightly or by a slight side slip. Only directly over the objective would the plane remain at constant speed and altitude. This might be for five or ten seconds. It would appear that at an altitude of 12,000 feet above which most day bombardment was carried on, under best conditions with the plane directly overhead, the pilot need only move the squadron once very eight seconds.

Colonel Cloke, in his figures for planes brought down, fails to make any difference for the planes brought down by machine-gun fire at low altitude and those brought down by 75's anti-aircraft fire at 12,000 feet. Naturally a plane "trench strafing," so-called, is very liable to be brought down, often being as low as 100 feet. In his figures of "results of the entire war," out of 58 planes brought down by U. S. anti-air craft fire 41 were brought down by machine guns. Certainly the greater part of the planes brought down by anti-aircraft fire in all armies was brought down by machine guns during drives when "*at all costs*" orders had been issued and planes were sent over at very low altitudes to shoot up trenches or troop trains.

Under the heading "Rapidly Gaining on the Airplane" Colonel Cloke gives us the results of target practice at Fort Tilden in 1925—one "hit" for every 22 shots fired. How was this result obtained? Was the target altitude at 12,000 feet? Was the pilot changing his altitude or direction every eight seconds? Did the pilot try holding his plane "in the sun"—a maneuver universally used by all pilots—which keeps the plane as much as possible between the sun and the anti-aircraft batteries? The author does not say, but tries to leave the impression that the "tests" were made under the same conditions as held in the last war.

Colonel Cloke ends his article by saying that after the "first volley of shell bursts" his batteries would "squirt the hose" on an approaching group of bombing planes with "corrections based on observation being applied from time to time." I do not know what "from time to time" means but I believe the "times" would have to be about eight seconds apart. His observers as yet cannot do this apparently.

However, I am glad to see that our "watchdogs of national defense" are going to make anti-aircraft guns more efficient. They will always have their function of keeping planes at a reasonable altitude, say 10,000 feet. But I believe from experience that by far the best defense against bombardment planes is pursuit planes. I hope the government will not spend too much on the anti-aircraft guns.

Gardiner H. Fiske
Former First Lieutenant 20th A. S.
First Bombardment Group

Colonel Cloke, author of the article under discussion, was asked to express his opinion on this letter and his reply follows:

Editor, Scientific American:

I have your letter with the enclosure. Permit me to reply as follows:

The basic assumption that aircraft travel in a straight line at constant speed and at uniform altitude is the theory only. This theory becomes more and more fragile as the type of plane varies from the heavy bomber. There are many types of anti-aircraft weapons, as follows:

Thirty-calibre machine gun
Fifty-calibre machine gun (Max. Vert. Range, 16,000 feet)
37 M M '25 (Max. Vert. Range, 14,000 feet)
3-inch '23 (Max. Vert. Range, 31,000 feet)
105 M M '26 (Max. Vert. Range, 42,000 feet)

We have a gun for each type of plane. For the swift-moving, sliding, zigzagging or tumbling pursuit plane, the machine guns are used as the weapon. The heavier types, such as bombers, when not directly over the enemy are assumed to take a straight line course at a constant speed and altitude. This assumption may be wrong in some minor details, but it is the basic assumption made and, where a bombing squadron is discovered changing altitude and skidding to the right or left or side-slipping (this is readily and quickly discovered by fire-control instruments) a correction can be applied on the gun-sights for this.

There is no doubt but that the best weapon against enemy planes is the pursuit plane, but it is also a fact that anti-aircraft artillery bears the same relation to the aircraft of our own forces, and has practically the same functions to perform as do seacoast batteries bear to our own Navy in time of war.

The figures I have obtained for planes brought down et cetera can be found in *Army Ordnance*, published in Washington, D. C., September, October 1925, by the Army Ordnance Association.

The "squirting the hose" proposition consists of the use of the 37 M M gun, which has a ceiling of 14,000 feet, effective range. This is an automatic gun, and although in its preliminary stage of development, it is effective. It pours a stream of fire as does any machine gun with tracer ammunition on the enemy plane. By observation of fire in this case is meant following the stream of tracer projectiles by eye, and moving the gun on to the target.

It cannot be positively stated at the present time that our Ordnance Department will be able to produce a 3-inch automatic gun. They hope, however, to be able to do this and claim that it can be done. The production of a three-inch, high velocity, automatic gun with tracer ammunition and supersensitive fuse will solve the anti-aircraft problem. Naturally the question is asked "How about ammunition supply?" The answer is, less ammunition would be needed in this case for the reason that it would take but a short time to destroy a plane.

I do not believe for a minute that anti-aircraft defense should be limited to land guns, but that the first defense against enemy aircraft should be our own aircraft, but, as with the Navy, our own aircraft should be free to move wherever necessary for concentration purposes and for our offensive attack in the same way in which our Navy is now permitted greater freedom of action due to the protective value of seacoast fortifications.

There is a slight misunderstanding perhaps on the part of some of the readers of this article with reference to the basic assumption. This basic assumption is made for the period of time included between the "time when *the fuse is set* and the projectile bursts." We are reducing this time continually. The time between setting the fuse and firing the gun is called the "dead time." This has heretofore been considered as eight seconds, but there is now in the experimental laboratory of the Ordnance Department a device for automatic fuse setting. This will reduce the time between fuse setting and gun fire, "dead time," to about two seconds. The time of flight for the 105 M M gun will also be materially reduced due to the high velocity which will be given the projectile. With this time element reduced, any slight side-slipping, skidding or peaking by a heavy bombing plane would not produce errors so great as to destroy the hitting power or the effective burst range of the 105 M M projectile. In other words, direct hits with this type of gun are not always expected.

I hope this will clarify the situation for your correspondent and I am pleased with the fact that this article has caused argument and controversy.

H. E. Cloke,
Colonel, C. A. C.

Science and Money

Common Stocks—The Pendulum Investment

By Henry C. Trundle

financial structure and at times there are not enough profits for the tail to wag and for dividends.

Naturally not all common stocks are to be classed as "cats and dogs" for any number of companies have dividend records on the common which would do many a bond or preferred stock proud. Sometimes also there are no bonds or other class of stock outstanding so that every cent over and above operating expenses is available for distribution to the common. In considering the purchase of common shares it is well therefore to ascertain just what securities are ahead of them and what balances have been accruing to the shares from year to year.

Common Stocks as a Bonus

At the formation of a company the common stock is frequently created to be given as a bonus to the organizers in consideration of their risks in time and money and also in order to stimulate all concerned to the greatest efficiency. Preferred stock is usually accepted to the amount of the cash actually invested, and the money so obtained is utilized in the purchase of plant and property, which later may serve as security for mortgage loans. A further use of common stock for bonus purposes is made when it may be necessary to "window dress" or "sweeten" an offering of bonds or preferred stocks. The prospective value of such free stock has often made possible the quick sale of securities which otherwise might have remained on the dealers' shelves. In other instances common stock of then little or no value is included as a part of a unit of sale, the intention of the management being to ultimately retire the bonds and stocks ranking ahead of the common, which when accomplished would leave all net earnings available for dividends on that stock.

Economists have recently been giving serious consideration to the question of voting and non voting stocks. This question is important to common shareholders inasmuch as the control of the company may be held by a few men through the ownership of all of the voting shares, which actually may be only a few thousand shares in contrast to hundreds of thousands of the non-voting shares in the hands of the general public. The example is used of a very large automobile company, the control of which is held by a few men holding a small block of stock that may have cost them nothing whereas the public has an investment of over a hundred million dollars in the bonds, preferred and class "A" common shares none of which securities have voting power. This control of large corporations by a few insiders is also accomplished through the organization of holding companies, in each case the voting stock being retained by a smaller group, so that the final effect is for a few shares owned by a few men to control companies with huge capitalizations. The limitation of voting powers to one class of stock has been done principally at the behest of banking interests who desire to keep the control of companies but who wish to have the public put up the actual money. Such shares are usually the so-called Class "B" common and they are frequently not purchasable in the open market.

Voting Usually Done by Proxy

In actual practice stockholders do most of their voting by proxy so that within every company there must be a small group of men who have the responsibility of its management. The defenders of the system of voting and non-voting stocks cite this as an example, stating that it is preferable to have the control definitely in their hands through [...]nership of voting stocks [...]ave the control split up among so many persons and subject to outside influence. As a matter of fact it seems reasonable that the preferred stockholders and the bondholders should also have a voice in the management of the business in which they have invested. As such securities are endowed by law with certain rights which the common stock does not ordinarily have, the purchaser of the non voting common shares must realize his junior position and

Common Stocks Not Unsafe

The publication of several books within the past year and the subsequent newspaper and magazine discussions covering the advantages of common stocks for long time investment have changed the opinion of many persons who have considered such stocks as purely speculative and unsuitable for conservative minded investors. The result of these studies has been to establish that over a period of years common stocks afford a larger income and a greater appreciation in principal than do bonds or preferred stocks. While it may happen that dividends are discontinued for several years, causing a decline in market value, it was shown that the total dividends, extras, et cetera, paid on the common are in excess of the amount of interest or preferred dividends paid during the same period. The further contention was that the common shares, fluctuating with relation to the value of money and in accordance with economic conditions, provide opportunities for real profit. However, it was expected that purchases and sales would be made at the proper levels and the fact that income must be certain and the capital kept intact was counted out of the argument.

This much is true, that when the affairs of a company are in such a condition that the dividends have to be discontinued on the common, the position of the preferred stock and the bonds is lessened. A decline in market value of these securities naturally follows and default in interest or dividend payments is possible. It is only fair to say, however, that soundly managed companies build up reserves to tide them over temporary critical situations and that fixed charges can be met out of surplus for some time even though current earnings are insufficient.

Gage the Pendulum's Swing

One of the difficulties in owning common stocks is that information regarding the course of earnings and other data is very hard to obtain. For reasons of competition industrial concerns are not wont to give out earnings statistics except when compelled to or at the close of a year. Consequently the shareholder may go for many months on the theory that his company is prospering whereas the opposite may be the true situation. This condition is somewhat better in the case of railroads for monthly statements are published by them giving the earnings car loadings and other information upon which the decision to buy or sell shares may be based. Earnings of railroad companies fluctuate less than do those of industrial companies, but they are not as stable as the earnings of public utility companies. One good feature of the income of electric light and power, gas and water companies is that the trend has been consistently upward and if utility shares are not purchased at the height of a bull movement but are bought at a level in proper relation to the earnings the buyer should confidently expect to see a steady appreciation in market value over a period of years.

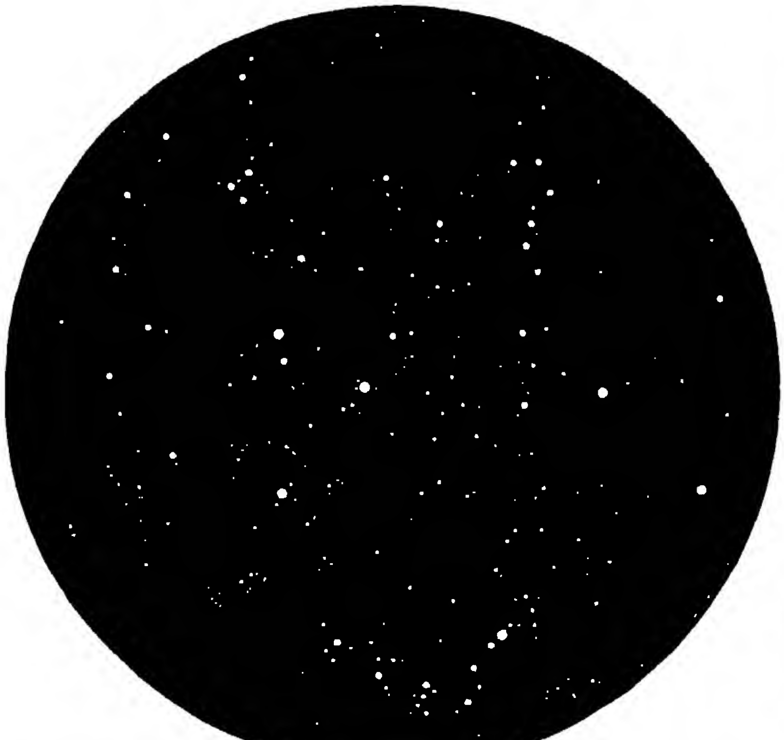
The policy of many utility companies of

paying dividends in stock, if preferred to cash, has increased the popularity of such shares, for as the market price of the stock advances the dividends so received have an increased value. The companies gain by this procedure as cash is conserved which can be used for extensions or equipment, thus doing away with public borrowing for such purposes. It possibly is to the investor's advantage to take his dividends in stock as a utility company can undoubtedly earn more on its money than the individual.

There is plenty of money to be made in common stocks, all agree but when to buy and when to sell is the great problem. The price pendulum is long, the swings are irregular and the turns almost defy detection. Who dares to buy when depression fills the air and who wants to sell when prosperity seems never ending? Yet this is just what should be done. But it took real nerve to purchase the common shares of our railroads, industrials and utilities a few years ago which now are quoted many times their former values. And it took courage to decide to sell five or six months ago when every stock on the list was being boomed for further advances. Those who have timed their operations can show handsome profits, while others less fortunate probably have losses from which it will take a long time to make a complete recovery.

The Heavens in July

By Professor Henry Norris Russell, Ph.D.



At 11 o'clock: July 7
At 10½ o'clock: July 14
At 10 o'clock: July 22
At 9½ o'clock: July 30
At 9 o'clock: Aug. 7
At 8½ o'clock: Aug. 14
At 8 o'clock: Aug. 22

The hours given are in Standard Time. When local summer time is in effect, they must be made one hour later: 12 o'clock on July 7, etc.

NIGHT SKY: JULY AND AUGUST

The Heavens

On our star map this month we find the Milky Way passing almost overhead, with Cassiopeia, Cepheus, Cygnus, Lyra, Aquila and Sagittarius and Scorpio strung along its length from north to south. Andromeda, Pegasus, Aquarius and Capricornus are east of the Galaxy. Ophiuchus and Libra are in the southwest. Hercules, Corona, Bootes and Virgo in the west. Ursa Major in the northwest, and Draco and Ursa Minor in the north.

The Planets

Mercury is an evening star all this month and is well visible being 26° from the sun at the time of greatest elongation on the 11th. On this date he remains above the horizon until 8 50 P.M. and should be easily visible in the twilight.

Venus is a morning star far north in the heavens and very conspicuous, and rises at 2 30 A.M. in the middle of the month. Mars is in quadrature west of the sun on the 9th and rises just before midnight (being 4° north of the equator). Although still more than eighty million miles away he is already a conspicuous object, and as bright as Capella or Vega.

Jupiter is in Aquarius, and approaching opposition. He rises a little after 10:00 P.M. at the beginning of the month and at about 8 00 P.M. at its close.

Saturn is in Libra well past opposition, and sets between 12 00 and 1 00 A.M. in the middle of the month. Uranus is in Pisces and visible in the morning hours. Neptune is in Leo and too near the sun to be observable.

The moon is in her last quarter at 8 00 A.M. on the 2nd, new at 6 00 P.M. on the 9th, in her first quarter at 10 00 P.M. on the 17th, full at midnight on the 24th, and in her first quarter again at 2 00 P.M. on the 31st. She is nearest the earth on the 26th, and farthest away on the 14th.

During the month she is in conjunction with Uranus on the 1st, Mars on the 2nd, Venus on the 6th, Mercury and Neptune on the 12th, Saturn on the 19th, Jupiter on the 26th, and Uranus again on the 28th, and Mars on the 31st.

On July 9th there occurs an annular eclipse of the sun. The path of central eclipse is entirely in the Pacific Ocean, starting north of New Guinea, ending 1,500 miles off the coast of Mexico, and passing over no charted land. A partial eclipse on the southern edge of the sun is visible in all parts of the United States south of a line drawn from Savannah to the southern most part of Alaska.

For observers east of the Mississippi the eclipse will be a small one just before sunset, but in California it will be of considerable magnitude and comes between 3 30 and 5 30 P.M., so that it will be worth looking at

Commercial Property News

A Department of Facts and Notes of Interest to Patentees and Owners of Trademark Rights

Conducted by Milton Wright

Don'ts for Inventors

WHILE it is true that many of the great inventions of the past have been made by outsiders, most of the successful inventions today are made by men who have a thorough knowledge of the field in which they are working. If you are a printer, for example, the chances are that any invention in the printing art that you might make would be of real practical value, for you are inventing in a field with which you are familiar In some other field where you have only a slight theoretical knowledge your ideas might appear to be all right but probably would be rejected by manufacturers as being visionary

Don't choose a complex technical field for your inventive ability unless you have technical knowledge

Mr. Brann Buys a White Elephant

THE fact that Patent Office models were to be sold some time ago was widely advertised. Who bought those models, however, and what has become of them has remained a mystery so far as the general public is concerned. Here is the story

Harry Brann, a speculator living in New York City, read an alluring newspaper article about the wonderful models, many of them of industrial or scientific importance which were to be sold because Congress was unwilling to continue to appropriate large sums annually for the purpose of storing them. Mr Brann boarded a train, went to Washington and attended the sale Two or three hundred other men were there, all bidding on the big miscellaneous collection of Patent Office models. He joined in, had the lot knocked down to him for $6,500, and paid a substantial deposit.

In due time thirty-six large packing cases, upon which he had to pay express charges of $200, were delivered to his rooms in New York. There was no space in his quarters for such a large assortment and he had to find storage elsewhere Two of the cases he opened up and displayed the contents in his rooms.

"Now that I have this large and valuable collection, I do not know what to do with it," said Mr Brann, calling at the Scientific American offices for advice in the matter "There are inventions of every imaginable kind. Here is a list of some picked at random from the ones at my home

The mailing machine invented by A. Knowlton in 1880

The coffee pot invented by J Zimmerman in 1867

The flywheel for engines invented by Pierre E. Jay in 1878

The grinding mill invented by W N Cosgrove in 1881

The magnetic telegraph invented by Charles Kirchhof in 1865.

The cancelling machine for bonds invented by Joseph N Hurley in 1887

The boot tree invented by W Upfield in 1857

The cream freezer invented by E. E. Seaman in 1848.

The clothes wringer invented by J H. Kobser in 1872.

The wash tub invented by J Wright in 1851.

"There is no doubt that a lot of valuable models are contained in this collection, but what they are, frankly, I do not know Some of them would be of interest to industrial organizations founded on particular inventions. Others would have a personal interest for descendants of inventors.

"I have offered the collection to a number of leading men and organizations, including Henry Ford, Thomas Edison, W C. Durant, and the American Telephone and Telegraph Company I hope somebody will take it off my hands for it is really a white elephant White elephants are very valuable, but what can you do with them?"

A Recipe for Wealth

THE story of the man who tried many things, failed at them all, and then made a fortune by writing a book on How to Succeed" is an old one The reverse of that story comes to light in a fraud order by the Postmaster General barring the use of the mails to V M Thompson and Company of Cincinnati Ohio

The business consisted principally, the Postmaster found of selling by mail books and pamphlets which purported to aid the purchaser to achieve financial success. 'Stepping Stones to Wealth," 'Building Your Business by Mail" and 'Real Experience' were the titles of three of them Thompson advertised that he himself had been led "straight to success" by means of the information in one of the books he was selling. He also advertised that his concern was a big supply house and filled all orders for books the same day they were received

As a matter of fact, Thompson and his wife lived in two small rooms over a barber shop in one of the poorer sections of Cincinnati One of the rooms they used as a kitchen and the other as a bedroom and office. The total receipts from the business for a year were $1 000 and of this $750 was spent for postage and printed matter Hundreds of complaints were received by the Post Office because of months of delay in receiving books ordered Thompson's publishers refused to make deliveries to him until he paid his printing bill

Nevertheless, Thompson was continuing his advertising in undiminished volume until stopped by the Postmaster General If the printer and the public had only had patience enough, who knows but what he might have made his success story come true?

Scrapped on Delivery

"DO you expect me to pay this bill of $2,500 bills for labels, when you know they're useless?" demanded a manufacturer recently

"Certainly," replied the lithographer to whom he was protesting.

"But didn't you suggest the design for them?"

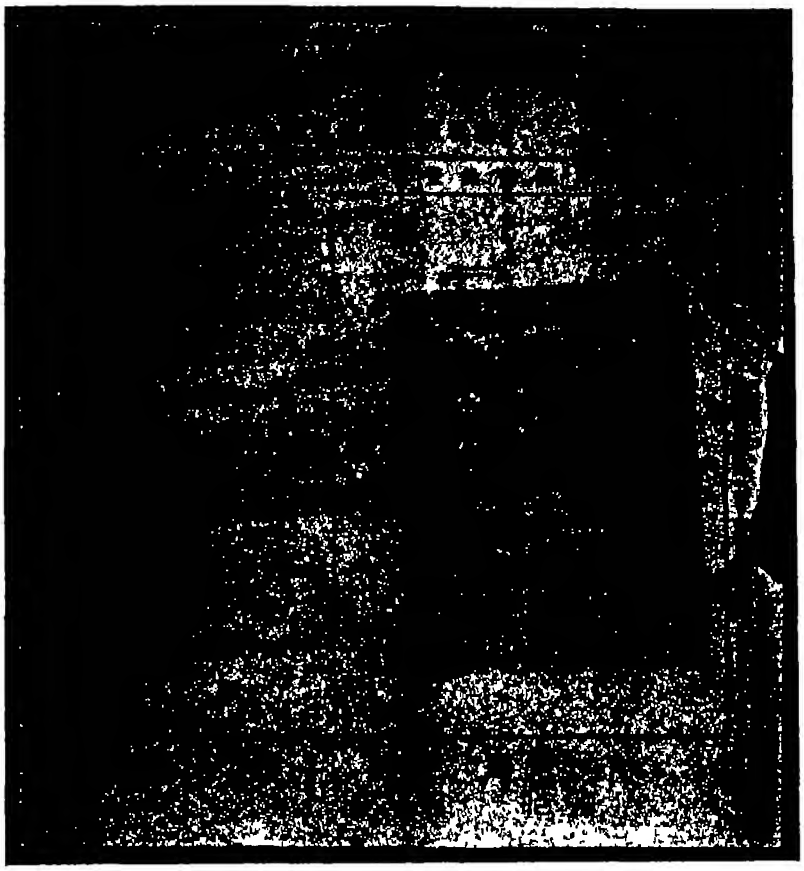
'Yes"

"And don't we now know that design is the property of another manufacturer and isn't he ready and able to prevent my using it?"

"That's true, but they are your labels. I printed them for you on your order"

So they went at it The manufacturer was out $2,500, the lithographer lost the future business of a good customer All because nobody had thought before having the labels made to find out whether or not the design already was registered Either party readily could have found out through his lawyer that the right to use a label like that belonged to another firm

Within a period of three weeks four such cases were brought to this editor's attention By the same lack of forethought a drug manufacturer was out $2,600, a perfume manufacturer $800, a hosiery mill $1,500 and a maker of food products $2,500 It is a costly form of carelessness that seems to be growing.



This is a Japanese certificate of registration for American made cotton goods. Registrants are advised to place the words "Tō roku shō hiō" on registered goods as this means "Registered Trademark" and warns would-be infringers

Patents Recently Issued

Pertaining to Apparel

SLEEPING GARMENT — Which combines within itself the adaptability for use as a bath robe, in addition to its main use Patent 1574051 C Hildreth, 1842 Pepper Ave, Lincoln, Neb.

WATERPROOF FOOTWEAR.—Which has the appearance of the ordinary shoe, but will wear longer, the leather not drying out as fast as ordinary leather Patent 1577701 L. Drechsler, 1314 Stoltman, St. Louis, Mo

Chemical Processes

PROCESS FOR PRODUCING BORAX AND SODIUM BICARBONATE FROM LAKE BRINES — By evaporation, whereby the crystal borax and sodium bicarbonate are precipitated and heated to substantially boiling temperature Patent 1573259 M V Lowry, c/o Western Chemical Co., Syndicate Bldg, Oakland, Calif.

REFINING PROCESS FOR PEARL ESSENCE. —Wherein the raw material containing the brilliant crystalloids is treated by means of a biological reagent, and the crystalloids separated from the residues. Patent 1576,454. J Paisseau, 5 Rue Blondel Courbevole, France.

Of General Interest

SCALP-TONIC APPLICATOR.—Whereby the tonic may be applied and rubbed into the scalp substantially at the same time Patent 1574118 P Coviello, 430 W 42nd St, New York N Y

GRAVE MARKER.—Which affords facilities for supporting a card containing data the card being protected against the action of sunlight and weather Patent 1574621 P J Good, Camden, Maine

SIGN —Having removable letters and a holder for supporting and displaying the letters in desirable relation to one another Patent 1574652 A Holder, 212 E 25th St, Los Angeles, Calif

CESSPOOL —So constructed that the pipe or conduit will never become clogged with grease or solids which gravitate to the bottom. Patent 1574003 W T Burtis, Glen Head, L I, N Y

CONVERTIBLE FLOWERPOT AND HANGING BASKET —Which will supply plants with water in a proper and effective manner without danger of the water spilling Patent 1572548 R. E Mattison, Box 354 Montello, Wis.

CALCULATOR.—Especially adapted for the use of linemen wiremen, and engineers for determining wire sizes for light or power Patent 1572547 R. W Mulder, c/o Kenlin, Roedell & Hoffman, Bank & Insurance Bldg, Dubuque, Iowa

TROLLING GEAR.—Having a spinner adapted to function at or directly near the point of the hook for fresh or salt water trolling Patent 1577288. —A W Wilson, 180 Duboce Ave., San Francisco, Calif

Concrete Reenforcement—Which may be assembled and interlocked in skeleton structure and rigidly secured together by the solidification of the concrete. Patent 1573715. G M Nelson, Box Q, Monterey, Calif

Casement Window—In which the frame and sash are so constructed as to effectively prevent the ingress of moisture and air, when closed. Patent 1576161. J Polachek, J Jepsen and F Persson, c/o Polachek Bronze & Iron Co, 176 Hancock St., Long Island City, N Y

Telephone Directory Stand—Having means for conveniently holding an indicia bearing sheet of telephone numbers against accidental obliteration. Patent 1573560. M H Mann, 55 Second St, San Francisco, Calif

Price Tag Holder.—For displaying price tags in front of goods disposed on shelves in stores handling a miscellaneous assembly of goods. Patent 1572094. D Garfinkle, 2407 San Jose Ave, Alameda, Calif

Self Locking Cover—Particularly adapted for use in connection with milk can covers of usual form without requiring change in the construction. Patent 1573279. I. V Silveira, P O Box 130, San Jose, Calif

Mail Box—Which affords facilities for preventing unauthorized removal of mail or articles yet permits easy access by authorized persons. Patent 1574354. H C Barth, Helena Apartments, Helena, Mont.

Carrier or Holder for Artificial Bait—In which a series of artificial minnows may be supported and protected, yet permit of ready release and selection. Patent 1574,416. F H Campbell, Lewisburg, W Va.

Safety Apparatus for Use in Mines—Designed to cut off the supply of air to regions affected to explosion or fire, thereby saving life and property. Patent 1575026. H W Haupanen, Box 80, Sturgis, Ky

Door Construction—For show cases, cabinets, and like structures, whereby the door is continuously urged toward closed position. Patent 1576008. I G Deltz, 1507½ So Main St, Tulsa, Okla

Jetty—Which will effectually prevent the erosion of river banks and maintain the river along a predetermined course. Patent 1574,133. H F Kellner, Silver Lake, Kansas

Stiffening and Protecting Device for Rugs—In the form of a flat element having attaching means for maintaining the corners flatwise and preventing curling. Patent 1573828. J L Hamilton, Red Bluff, Calif

Fixture Holder.—Adapted to properly mount and hold the so called recessed type of fixtures in bath room walls which are not tiled. Patent 1576457. J H Patty, 1012 Quinton Ave, Trenton, N J

Gate.—Automatically operable by an automobile or truck, to permit the same to pass through the gate automatically closing after the passage. Patent 1576442. J W Matthews, Menard, Texas.

Earring Safety Guard—For supporting an earring and relieving the pain frequently caused by the hanging weight stopping blood circulation. Patent 1576372. E J Shea, 32 Court St, Brooklyn, N Y

Dual Sounding Rattle—Which produces both a rattling sound and a sound imitating a baby's voice, by manipulations of the handle. Patent 1576231. I E. Cohn, 64 4th Ave, New York, N Y

Size Indicator for Garment Hangers—Designed to bear indicia relative to the garment, the marking device being readily interchangeable. Patent 1575775. B Lesser, 33 W 34th St, Room 804, New York, N Y

Dispensing Device—In which novel means is employed for releasing merchandise, such as candy and the like from a normally closed container. Patent 1575072. B B Cochran, c/o Goblin Mint Co, 1241 Belmont Ave, Chicago, Ill

Ironing Board Attachment—Adapted to be extended longitudinally of the edges of the board for supporting large pieces of goods. Patent 1576929. C A Parkinson, 819 Wise St., Berlin, Wis

Wrist Pencil and Holder Therefor—Capable of being held in a support with a wrist watch, a spring and flexible connection securing the pencil. Patent 1577272. L F Treadaway, 12 Davis Bldg, Daytona, Beach, Fla

Dispensing Device—In the form of a fountain tooth brush, in a cylindrical hold, not materially in excess of a fountain pen. Patent 1576750. W. W Kinsley, Jamestown, Kansas

Surface Protector.—For the bases of lamps telephones, and similar articles, supporting the base, and preventing marring or scratching surfaces. Patent 1577281. S Matzner, 1350 Broadway New York N Y

Article Carrier—Which may be applied to the handle bars of a baby carriage, for the transportation of packages and parcels. Patent 1577208. Mary A Roeller, 3407 41st St., Long Island City, N Y

Clothes Hanger.—Adapted to support one or several articles and to be capable of removal or for storage of ladies dresses. Patent 1577230. L I Nash, 1027 Rose St, Far Rockaway, N Y

Advertising Device.—Which displays matter to be advertised in a unique form, and employs a minimum number of simple parts. Patent 1577213. R S Fenner, 116 1st St., Newark, N J

Quilt Cover.—With means for fastening the same in such manner that the quilt and cover are held in proper relation. Patent 1577220. R Greenberg, 880 Huntspoint Ave, Bronx N Y

Scaffold Bracket—Readily attached to the wall of a building, is adjustable, strong, and may be folded when not in use. Patent 1577231. J Hubeny, 533 Spring St, Elizabeth, N J

Artificial Christmas Tree—Composed of readily assembled and separable parts, which may be stored in a small space. Patent 1577207. W Dieperink Langereis, 517 E. 2nd St. Jamestown, N Y

Fire Escape—Comprising a steel cable with combined guiding and braking means manually controlled and an automatically controlled weight regulator. Patent 1578,108. N Tobias, c/o S M A de Sousa, 32 Church St. Kingston, Jamaica

Screen—Which functions not only as a screen, but as a ventilator which enables the window to be left open in stormy weather. Patent 1578095. C R Ryan, Box 63, Cuba, N Y

Rubber Toothbrush—Adapted to effectively clean all the surfaces of the teeth and massage the gums without injuring the same. Patent 1578071. J Chandler 302 Providence Exchange Toledo Ohio

Book Match Cover—Capable of being folded to convert the same into a receptacle for ashes burnt matches, or smoking refuse. Patent 1578119. A B Harris, 522 5th Ave, New York N Y

Jellifying Product and Method of Making Same—Whereby when the product is removed from the container, they will of themselves divide into separate portions. Patent 1578122. M W Higgins, 14 Carstensen Road Scarsdale N Y

Curtain Draper—Conveniently attached to a window frame, will be out of the way when not in use, and readily moved to operative position. Patent 1577480. R A Norton, Drawer D P 23, Fort Lauderdale, Fla

Support and Shield for Flatirons—Providing means whereby the iron may be supported so that the work surface may be employed for steaming fabric. Patent 1577,790. T A C Cook, 3430 Sheridan Road, Chicago Ill

Sanitary Cover for Telephone Mouthpieces—An inexpensive device for preventing the collection of germs or dust, thus making the mouthpiece more sanitary. Patent 1578165. G B Mullen, Bell Ave, Bayside, N Y

Doll's Eyes—With means for properly positioning the eyes at the openings in the head, without the eye-balls rubbing or binding. Patent 1578176. I A Rommer c/o Ideal Toy & Novelty Co, 273 Van Sinderen Ave Brooklyn, N Y

Sanctuary Lamp—Wherein means are provided for utilizing a candle, and automatically causing the light to remain in the same position. Patent 1578087. R C Norton, 350 Mercer St Jersey City, N J

Toy Scale—Constructed sufficiently strong to stand rough usage by children, without breakage. Patent 1578137. J Kaplal, 380 Thames St Newport, R I

Cooking Apparatus—Particularly designed for baking tortillas so that both sides of the disk may be properly baked. Patent 1579147. L Romero c/o Dr J Navarro Sa, 218 Juarez, Mexico

Trunk—Giving easy access to the interior of the end portions without detaching various trays from the body. Patent 1577,745. J C Grider, 2523 Hillegas Ave, Berkeley, Calif

Calendar.—By which may be readily determined the day of the week on which any predetermined day of the year falls. Patent 1577967. G F Hawley, 141 California St., San Francisco, Calif

Attachment for Fountain Pens and the Like.—Which consists of a rubber collar for holding a combined fountain pen and automatic pencil in the coat of the user. Patent 1578596. L. Fritz, 648 S State St., Chicago, Ill.

Ventilated Seat—For use in railroad coaches or vehicles, to aid in keeping the occupant cool by air in summer weather. Patent 1568471. M. Roemer, Lost Hills, Calif

Combined Match Box and Belt Buckle.—Which affords facilities for detachably connecting the ends of a belt, and will occupy but little more space than ordinary belts. Patent 1578408. J. Rankin, Louisa, Ky

Frame Construction—For openings such as windows, eliminating casings and wood trim and providing a guide to which a plastic covering may be finished. Patent 1578790. I A Baum c/o Stickley & Fitzhugh, 1010 Federal Bank Bldg, Memphis, Tenn

Collapsible Ironing Board—Especially strong and yet when folded can be stored in a trunk or suit case. Patent 1579123. M F McCabe, 78 Prospect Park West, Brooklyn, N Y

Key Holder.—Particularly designed to receive the keys of a motor car, whereby the keys may be readily swung to position for use. Patent 1579153. A. A. O Secior, 15 Maiden Lane, New York, N Y

Ring—Having the usual appearance while certain parts may be readily removed and replaced by a different ornamentation. Patent 1579148. R. Rosenthal, 15 John St., New York, N Y

Folding Comb—Which facilitates the carrying of an average sized comb in a small amount of space. Patent 1579143. M Rabb, c/o Hercules Novelty Mfg Co, 120 South St. Newark N J

Bed—So constructed that when not in use it may be folded and stored in a small space. Patent 1579115. E P Kebbe, 342 Broadway, Everett, Mass.

Moistener—For moistening and for flavoring tobacco products, the device is freely movable and obviates the use of absorbent material. Patent 1579111. J R. Hinkson 580 Parkside Ave, Brooklyn, N Y

Shaving Outfit—Wherein the soap and the container are formed to co act and present a structure acting as an ordinary shaving mug. Patent 1579103. G W Gerow, Vail Gate, N Y

Container for Folded Tissue Toilet Paper—By means of which the withdrawal of the tissue paper from the container is facilitated. Patent 1577094. L. J Arms, c/o R. C Pell Jr San Francisco, Calif

Hardware and Tools

Pruning Implement—For the use of gardeners and beet thinners, the device having changeable blades of varying width. Patent 1572426. J H Foot, R F D No 1, Delta, Utah

Hack Saw Frame.—Which is extensible and adjustable, and equally well adapted to be used upon work of large or small dimensions. Patent 1572823. F A Stierheim, Riceville, Pa

Surface Cleaner.—Having a pair of flexible blades which frictionally engage the surface to be cleaned. Patent 1574666. W B. Lynch, 4710 6th Ave Brooklyn, N Y

Attachment for Miter Boxes—In which the saw is not only guided in the cutting movement but supported at the same time. Patent 1574063. E. Leake, Jr, 3281 Hull Ave, Bronx N Y

Insertable Saw Tooth and Holder Therefore—For holding the tooth securely in such manner that strain and pressure will not affect the tension of the saw. Patent 1574600. A M. Currier, 315 E 3rd St. Aberdeen, Wash

Valve.—Wherein the coacting faces of the seat and valve plug will set up a grinding action to prevent leakage. Patent 1575449. S L Mozian, Ward's Island, New York, N Y

Drill.—For deep wells, with means for building up a concrete lining or casing for the well during the actual drilling operation. Patent 1574040. A W Lasher, 302 Oak Ave, Oakland, Calif

Turret-Tool Holder.—Constructed to hold a plurality of standard bits, and to permit accurate presentation of the tools to the work in proper order. Patent 1574741. H B. Day, c/o E. J Crenshaw, Furniture Bldg, Evansville, Ind.

Paper Hanger's Knife Attachment.—Which is adapted to guard and guide the blade when trimming wall paper to fit the corners or baseboards of rooms. Patent 1574641. G A. Christopherson, 1547 California St., San Francisco, Calif.

Nonfreezing Sill Faucet—Especially designed for use on sills of dwellings or buildings where the discharge end is exposed to the weather. Patent 1575547. F Conrad and S Rasmussen, 109 Elm Ave., Bogota, N J

Nut Lock—Which affords facilities for releasably and securely holding a nut against retrograde movement on a bolt. Patent 1574619. F A. Gibson, Jupiter, Fla

Furniture Spring—The upper and larger end convolutions of which are connected and braced by suitable coil spring connecting elements. Patent 1576441. V. Masaucese, c/o A Verner, 470 9th Ave., New York, N Y

Peeler.—For fruit and vegetables, constructed with a coring edge, and a thumb guard for preventing thumb abrasions. Patent 1574284. J H Gills, Commercial Hotel, Gainesville, Texas.

Inside Pipe Cutter.—Adapted to be moved within a tubular member to the desired position and then operated to cut through the walls. Patent 1577474. G F. Le Bus, c/o Le Bus Rotary Tool Co., Electra, Texas.

Fence Construction—In which each unit consists of a pair of sections detachably connected, whereby a passageway between supports may be readily made. Patent 1578,217. J Sutter, 3 Hull Ave, Maspeth, N Y

Locking Device.—Capable of being used in conjunction with two closures, being carried by one and preventing the movement of both. Patent 1579107. F L. Hanle, 43 Morgan Place, Kearney N J

Clamp for Window Locks—For holding the two sashes of a window in spaced relation for ventilation, without permitting increase of the opening. Patent 1568374. A T Gibson, 427a Hawthorne Ave., Oakland, Cal

Can Perforating Device.—Usable with cans of various heights and diameters such as containers for milk and the like for forming an outlet and vent opening. Patent 1577957. D P Dalmas, 426 Tennessee St, Vallejo, Calif

Locking Plate for Cylinder Locks—Which will not only prevent the rotation of the lock, but will present an ornamental effect. Patent 1579130. J E. Phillips, 280 Convent Ave, New York, N Y

Valve for Water, Steam, Air, Gases, Oils and Other Fluids—Independent of discs of leather rubber or composite material for its cutting-off property. Patent 1578349. H C Nixon, 749 Ave N, So. Saskatchewan, Canada.

Heating and Lighting

Oven Closure.—For bakers' ovens, including cooperative doors for the introduction of goods of various sizes and to prevent unnecessary escape of heat. Patent 1576451. J Nolla, 42 Paterson Ave., New Brunswick, N J

Dry Heat Curing Cabinet—For use in vulcanizing rubber, more especially in the treating of shoes or tires. Patent 1577291. E. Nestler, c/o Nestler Rubber Fusing Co., 245 W 55th St., New York, N Y

Burner.—Especially designed for the burning of fluid fuel, whereby the assemblage provides for efficiency in the application of heat and the regulation of the fuel and air. The inventor has been granted two patents, 1578133 and 1578135. A Kois and A Zaugg, 5650 Linwood Ave., Highland Park, Detroit, Mich.

Safety Valve for Hot-Water Heaters.—Particularly adapted for use in cold climates, with the ordinary type of range having a water chamber for heating a system of pipes. Patent 1578046. H. H Logan, c/o Duro-Metal Products Co, 2649 N. Kildare Ave., Chicago, Ill.

Hot-Water Tank.—In which the upper part may be heated in a relatively short time and will remain hot a relatively long time. Patent 1581907. E. T Barron, 428 W Lake St., Minneapolis, Minn.

Machines and Mechanical Devices

LOOM BUNTER.—Which will function to positively stop the loom on a quarter of a pick or a quarter of a turn of the lay Patent 1576285 A. H. Landry, Box 15, Townsend, Mass.

WEIGHT SCALES — Which eliminates springs from its construction so that the scale will not lose its accuracy with use Patent 1578809 W M. Sanders, Eagle Creek, Ore.

SNOWPLOW —Having a power unit for picking up the snow, and a means for discharging the snow a distance to the road side Patent 1574230 F W Brown, c/o V F. Gabrielson, Court House, Fort Dodge, Iowa.

STILL.—Of the type known as coke stills especially adapted for use in refining oil, the device permits of expansion and contraction without buckling Patent 1575910 G H Hurshman, 770 C Y Ave, Graybull, Wyo.

TEASEL-CLEANING MACHINE.—Which will automatically clean a series of teasels, used in the manufacturing of nap goods, in a minimum time Patent 1577206. M Poetzsch, 91 Overbrook Road, Ridgewood, N J

CYLINDER PROTECTOR.—Providing means for preventing the accumulation of fallen rust, scale, sticks, etc in the working barrels of wells. Patent 1576026. A B Mueller, Runge, Texas.

LOADER CONVEYER.—Which can be easily adjusted to conduct material to a given point from a point within a considerable area Patent 1576010 W W Hudson, c/o Porcupine Paymaster Mine, So Porcupine, Ontario, Canada

DEVICE FOR SURFACING MOLDING OR THE LIKE.—By means of which molding can be polished before leaving the mill, thus obviating subsequent sand papering Patent 1576045 S E Eskew and L Harris, c/o Moses Pulverman, Benton, Ill.

BOTTLE WASHING DEVICE —Which may be connected with an ordinary household faucet for simultaneously cleansing the interior and exterior of a bottle Patent 1577236. G Huss, 357 E 87th St, New York, N Y

BOILER TUBE SCALING DEVICE —By means of which a piston with hammerlike stems encounter the walls of the tube as the piston is reciprocated Patent 1577300 S Sorensen, 1020 Castleton Ave, Port Richmond, S I, N Y

DASHPOT —For use with governors for engines, the device will take care of emergencies while ordinarily acting in the usual capacity Patent 1578148 O G Lissen, 151 Highland Ave, Jersey City, N J

WELDING MACHINE —Which allows of the forcing together of the two heated elements with sufficient speed to prevent cooling of the faces. Patent 1577818 C L Stancliff, 1005 Oregon St, East Bakersfield, Calif

BELT —Of heat resisting material, to be used as a conveyer or elevating belt Patent 1578727 Z. F Harshton c/o Imperial Belting Co, Lincoln and Kinzie Sts, Chicago, Ill

ELEVATOR SAFETY DEVICE —Automatically operated whenever a door is opened either on the elevator car, or in the shaftway, to lock the controlling mechanism of the car Patent 1578604 H G Hillman c/o J T Clark, 9 E. 30th St., New York, N Y

TACK DRIVER.—Particularly adapted for securing the covers on cheese boxes or other subjects ordinarily quite difficult to handle Patent 1579120 E J Kramer, 407 Harwood St., Green Bay, Wis.

CONDENSATION DRAIN DEVICE.—Adapted to be operatively connected to the air system of an air brake apparatus, or any other power mechanism Patent 1579073. H L Bullock, 84 Cloverdale Ave, North White Plains, N Y

Medical and Surgical Devices

TRUSS —Capable of a wide range of adjustment whereby the same may be readily regulated to register with the afflicted part. Patent 1581000 T McSherry, 10 Liberty St, Long Branch, N J

SYRINGE ASPIRATOR.—Which makes possible the aspiration of fluids from, and the injection of medicated fluids into the veins, arteries, or other cavities of the human body Patent 1572075. W. G. Painter, Big Stone Gap, Va.

SYRINGE.—Having a nozzle assemblage which will minimize or prevent discomfort and pain by reason of its mode of application Patent 1574604 W Richards, 13 Hertzel St., Warren, Pa

DOUCHE TABLE —The construction being simple and of such design that the water will drain off readily Patent 1572090. H F Wagley, Mineral Wells, Texas.

Musical Devices

TAMBOURINE.—Having an assemblage of jingle and castanet elements so associated with a sound board as to be effective in playing Patent 1576443 E C McElhany, 436 Portage St, Kalamazoo, Mich

XYLOPHONE. — The inventor has been granted two patents wherein the sounding members are suspended by a comparatively straight single member near each end, and metal sides support the strings which carry the vibratile members. Patents 1575900 and 1575963 W Bartholomae, c/o Bar Zim Toy Mfg Co, 113 4th Ave, New York, N Y

PEG FOR STRINGED INSTRUMENTS —In which the tension may be increased or decreased at will without the use of tools of any sort. Patent 1570987 M O Wickes Northampton, Mass.

Prime Movers and Their Accessories

VALVE.—A rotary valve, so constructed as to operate as a fan to scavenge the valve casing and combustion chamber Patent 1572085. C W Risden, 1452 W 49th St, Los Angeles, Calif

LUBRICATING SYSTEM FOR INTERNAL COMBUSTION ENGINES —Wherein the lubricant is supplied in proportion to the speed at which the engine is running and is shut off when the engine stops Patent 1574410 C. L. Powell, Mawry City, Tenn

ROTARY VALVE —Which will afford facilities for controlling admission of fluid fuel to one or more cylinders of an internal combustion engine Patent 1576591 C C Foss and D D DeLoach c/o C D Russell, 518 Realty Bldg, Savannah, Ga

ENGINE —By means of which the stroke of the slide valves associated with a plurality of cylinders may be simultaneously regulated to admit steam Patent 1576830 W V Jordan and T M Swank c/o T M Swank, Lecompto Citrus Co, Lecompto Fla

DYNAMIC COMPENSATOR —For use in connection with such prime movers as engines of motor vehicles alternating current induction motors steam turbines etc Patent 1578223 M J Waclaw, 649 E North St., Bethlehem Pa

Railways and Their Accessories

WATER COLUMN FOR LOCOMOTIVES — Which is of such a character that it will be universally applicable to different sizes and types of locomotives Patent 1575381 A H Oelkers, 796 E Walnut St, Springfield, Mo

RAIL STRAIGHTENER.—Which affords facilities for making use of a relatively slight force to bend a rail of relatively great resistance Patent 1578381 L. W Baker, General Delivery, Blue Rapids, Kans.

ROOF CONSTRUCTION —In which the running board and the roof sheets are combined to form a complete roof of a car, eliminating separate running boards Patent 1581078 A H Oelkers Chief Mech Engineer, St Louis & San Francisco R R. Co, Springfield Mo

Pertaining to Recreation

GOLF APPARATUS — Whereby various strokes of golf may be practiced indoors, and the values of a given shot on a regular course closely approximated Patent 1574,506. E. L Barnett, 149 Lexington Ave, New York, N Y

GOLF CLUB — Having means whereby the head and the shaft can be firmly and efficiently connected without the necessity of whipping them together Patent 1575400 C Sunter, c/o Thos Keogh, 233 Broadway, New York, N Y

WALKING TOY —Adapted to walk in simulation of the animal, or other object which the toy is constructed to represent. Patent 1576435 A Gund, Ridgefield, Conn

AMUSEMENT DEVICE.—Which may be located in public places affording amusement, and requiring skill in the manipulation of a coin to secure a prize. Patent 1578116. C Fleischer, 52 Van Sinderen Ave., Brooklyn, N. Y.

BASKETBALL GAME APPARATUS.—Whereby a game resembling all the plays which actually take place in a game of basketball, may be played Patent 1579172 J W Weaver, 415 Cutler St., Raleigh, N C

EXERCISING APPARATUS —By which various movements of the arms, legs and body can be effected to simulate rowing and other forms of exercise Patent 1577800 E T Randall, 117 W Ave 31 Los Angeles, Cal

Pertaining to Vehicles

SANDING DEVICE —By means of which the quantity of sand distributed in front of the wheels can be regulated from the driver's seat Patent 1575008 R H Conty, 1122 Hyde Park Blvd, Chicago Ill

PROTECTOR FOR AUTOMOBILES —In the form of a cover adapted to overlie the hinge of the hood to prevent the entrance of rain Patent 1575510 M J Schwanck, c/o Smith & Wild, 200 McCandless Bldg, Honolulu Territory of Hawaii

AXLE —For use on wagons constructed to obviate the need of reducing the cross section at the point of wheel attachment Patent 1575004 F M Kennedy, Clarendon Ark

SPRING PERCH REMOVER —For removing spring perches from the front axles of Ford cars without removing the axle from the car Patent 1575517 A I Albright and F L Myatt, Box 327, Monroe La

GLARESHIELD —Adapted to be mounted in front of the windshield to protect the eyes against sun rays and headlight glare Patent 1574800 A T Kellogg c/o The Texas Co Room 810, Houston, Texas

REMOVABLE FRAME FOR MOTOR OR LIKE VEHICLES —Having means for automatically fastening or rendering motionless movable glazed or other frames for vehicles Patent 1 76281 G Buchr, 2 Rue des Sablons Paris France

AUXILIARY RIM AND TIRE Which may be quickly disposed upon a vehicle wheel for taking the place of a deflated standard pneumatic tire Patent 1575056 L E Williams, Benton Ill

AUTO ATTACHMENT — For preventing rearward movement of a car when in operation, particularly when stalled or ascending a hill Patent 1576265 S Beringer, 203 Pondfield Rd Bronxville N Y

SIGNAL LAMP —Especially designed for use by traffic officers or drivers of vehicles adapted to be associated with the wrist and hand Patent 1576235 M M Cunningham Smith St Far Rockaway, N Y

AUTOMOBILE SPOTLIGHT —Which can be rotated horizontally or vertically by the turning of a shaft extending through the car body Patent 1571050 H E. Montgomery 8246 Northfield Ave, Detroit, Mich

RIM AND TIRE CONSTRUCTION FOR VEHICLE WHEELS —Whereby a tire having a given air capacity will be capable of sustaining a relatively great load without rupture Patent 1574277 M T Conroy c/o H M Grove, R F D No 1 Cuyahoga Falls Ohio

ENGINE EXHAUST — Which embodies a cut out readily opened to permit the gases to pass direct to the atmosphere in addition to the ordinary muffler Patent 1576040 W C Dial c/o H D Voris Hatcher Bldg, Pueblo, Colo

AUXILIARY ROAD SPRING —Which may be easily attached to the main road spring of an automobile to steady its action Patent 1576067 C A Rasco Merced Falls Calif

HEADLIGHT —In which the light itself is hidden and the rays directed downwardly to strike the road without striking the eyes of approaching drivers Patent 1576035 E P Cipperly 298 Yosemite Ave, San Jose, Calif

ROAD VEHICLE —Of the double bogie type so constructed as to permit steering with but little effort Patent 1517193 M H Churchill Shann, 548 Hanel at Albury New South Wales, Australia

SPRING SUSPENSE FOR VEHICLES —For resiliently supporting the body of a vehicle on the axle and replace the usual vehicle springs. Patent 1576001 A M Cowen 3120 Esplanade Ave New Orleans La

SIGNAL.—Conveniently operable by the driver of a vehicle to indicate his movements without disturbing his control of the vehicle Patent 1576536 R S Parker, 503 So Hickory St, Ottawa, Kans.

DIRECTION INDICATOR.—Which may be combined with the customary tail light of a vehicle and include a license plate holder Patent 1577113 A De Velasco, 2317 W 6th St., Los Angeles, Calif

AUTOMOBILE AWNING —Which may be attached to the windows, and removed at will to shade the eyes from the sun rays Patent 1576886. L. H Williams, c/o R L McDonald Mfg Co, 12th St & Penn St, Box 1177, St Joseph, Mo

COMBINED FASTENER AND HANDLE FOR AUTOMOBILE DOORS —Conveniently gripped to simultaneously release the latch and open the door both ornamental in appearance, simple and durable Patent 1578118. P H Gaskins, 1207 Graham Bldg, Jacksonville, Fla

REFLECTOR. For automobile headlights adapted to direct the rays of light so that practically all will illuminate the roadway without producing objectionable glare Patent 1578079 J G Davis, c/o L L Thalheimer, 1408½ Camp St Dallas, Texas

ANTISKID CHAIN FOR MOTOR VEHICLES — Attached to the ends of a bolt positioned through the felly transversely with the tread of a tire Patent 1577454 C G Drescher and C L Orrison c/o Orrison Sales & Service, Villa Grove, Ill

ELECTRICALLY HEATED STEERING WHEEL. Applied to internal portions of the rim, so that heat may be conducted throughout the circumferential portions of the hand grip Patent 1577987 W D Schwenk, Box 133, Ferndale Mich

TRACTOR —Having a novel arrangement of an arch axle and draw bar by means of which either cultivating or plowing implements may be drawn Patent 1578470 H A Stewart and P L Holt, 300 L Leonterdale St Tullahoma Tenn

BRAKE.—For use on automobiles or other vehicles engines and machinery utilizing brake shoes instead of the ordinary brake band Patent 1579100 W Fraser Dobbs Ferry N Y

STEERING POST FOR AUTOMOBILES That will be more convenient to handle than the posts ordinarily used, and will provide better locking means G R Dirr Santa Margarita, Calif

TRAFFIC SIGNAL.—Which affords a striking indication of changes in the rate or direction of motion which the driver intends to make Patent 1578410 C Elder 3917 Doniphan Ave, St Joseph Mo

Designs

DESIGN FOR A COAT Patent 69571 T Davis c/o Franklin Simon & Co, 38th St. & 5th Ave New York N Y

DESIGN FOR A COAT Patent 69572 T Davis c/o Franklin Simon & Co, 38th St & 5th Ave, New York, N Y

DESIGN FOR A DRESS Patent 69573 T Davis c/o Franklin Simon & Co, 38th St & 5th Ave New York N Y

DESIGN FOR A DRESS —Patent 69574 T Davis c/o Franklin Simon & Co, 38th St & 5th Ave New York, N Y

DESIGN FOR A TEXTILE FABRIC.—Patent 69600 R Schey c/o Max Kaufman & Co., 45 Leonard St, New York N Y

DESIGN FOR TEXTILE FABRIC —Patent 69610 R Schey c/o Max Kaufman & Co, 45 Leonard St, New York, N Y

DESIGN FOR AN AUTOMOBILE FLOWER VASE Patent 69681 D Weller c/o Moswell Mfg Co, 68 Grand St, New York, N Y

DESIGN FOR A PRINTED FABRIC —Patent 69671 R Schey, c/o Nathan H Rich & Bros., 140 5th Ave New York N Y

DESIGN FOR A DRESS —Patent 69687 T Davis, c/o Franklin Simon & Co, 38th St & 5th Ave, New York, N Y

DESIGN FOR A TEXTILE FABRIC OR THE LIKE —Patent 69698 C S Fowler, Westerly R I

DESIGN FOR WRAPPING PAPER.—Patent 69727 R Wertheimer c/o Cohn Hale Max Co 93 Franklin St New York N Y

DESIGN FOR A STOVE — Patent 69731 W F Allen c/o Allen Mfg Co, Nashville, Tenn

DESIGN FOR A RING OR SIMILAR ARTICLE —Patent 69800 B Veit, 935 St. Nicholas Ave New York N Y

DESIGN FOR AN ELECTRIC LIGHT FIXTURE Patent 69797 E J Dietzmann, 834 So Figueroa St., Los Angeles, Cal

DESIGN FOR A LIQUID DISPENSER. Patent 69969 W A Schatz c/o Rotax Co, 380 E 133d St New York, N Y

DESIGN FOR A LAMP MOUNTING Patent 69998 A J Kollman, 200 E 59th St., New York, N Y.

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1736—1819

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He then became interested in Thomas Newcomen's steam engine which was at that time the most advanced type and was used solely for pumping water. The history of how he worked on the subject is too long to relate here but enough to say he secured his first patent in 1769. This patent introduced the following features condenser air pump lubricated piston packing closed cylinder encased cylinder in non conducting material and the steam jacket. Owing to financial difficulties he was forced to temporarily abandon this work and took up surveying becoming quite well known in the civil engineering field.

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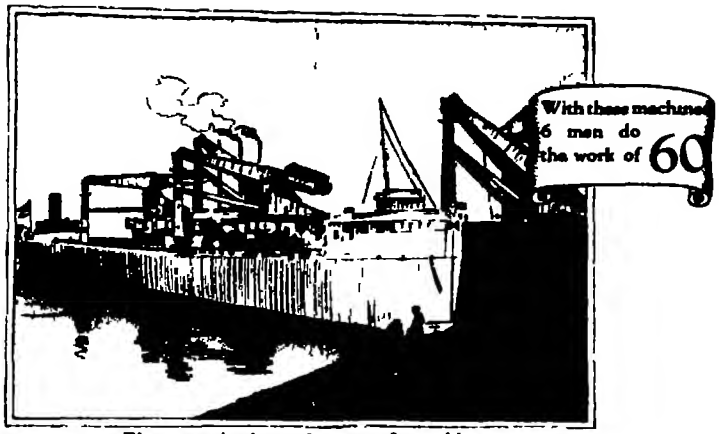

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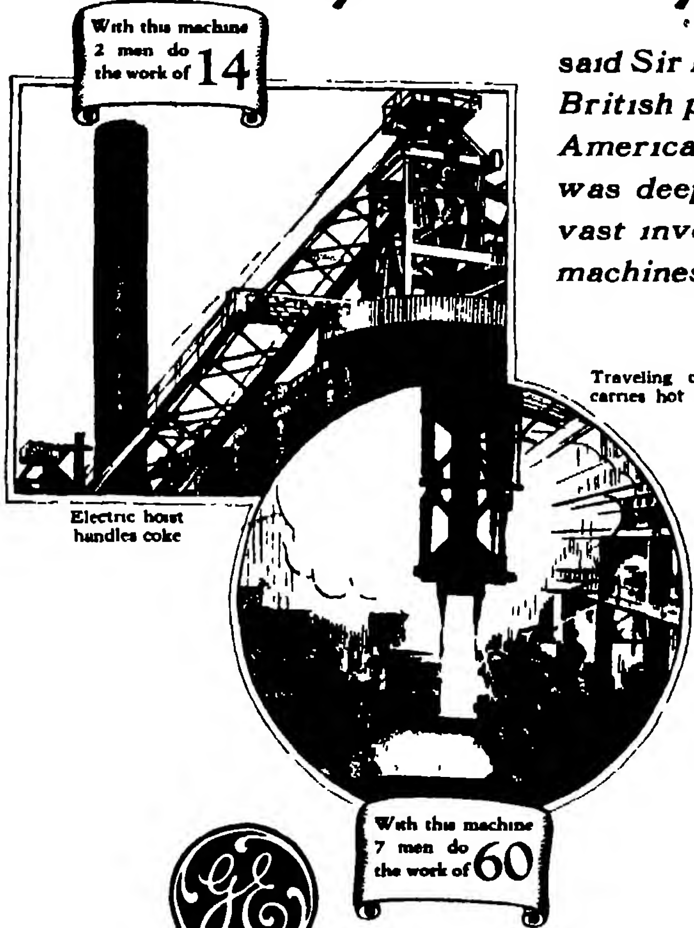

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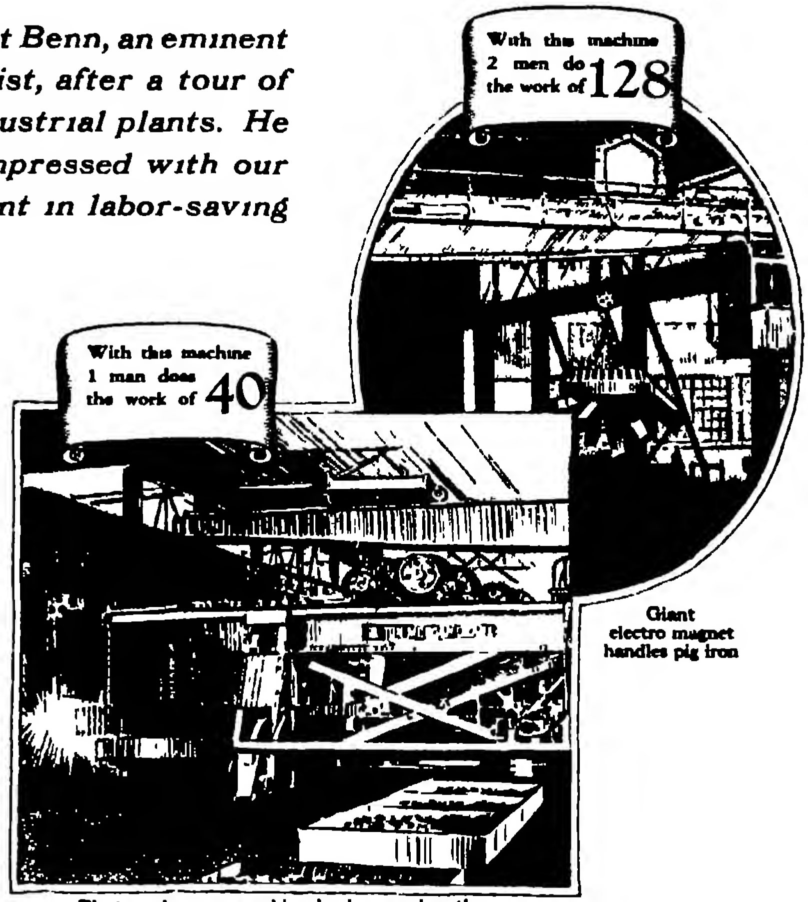

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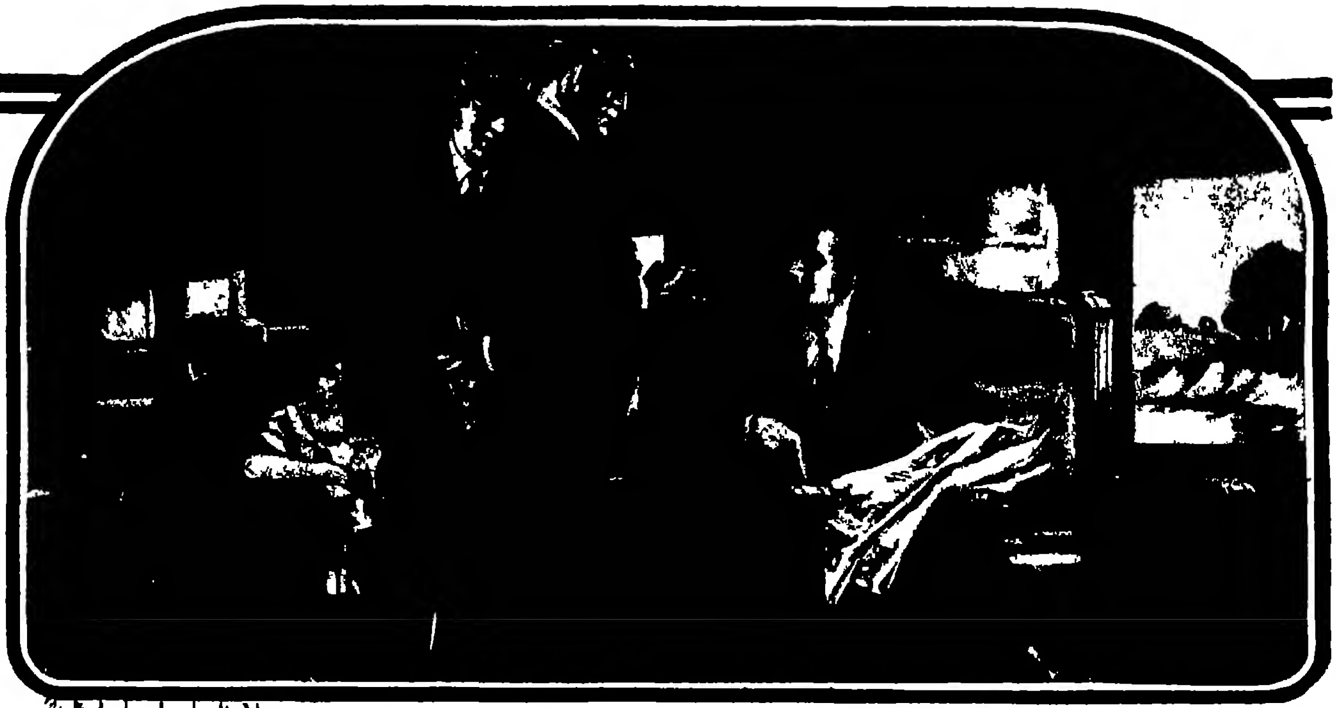
Many busy hands br ii ling threa ts of co ve t on—the t lepho t
Assembling a giant switchboard, m le up of thousa ids of parts
Part of the great unseen equipment that goes into a telephone exchange
Just a wire—but see all the equipment needed to make it
Huge machines like these are needed to produce telephone cable.
Back of your telephone
Western Electric
SINCE 1882 MANUFACTURERS FOR THE BELL SYSTEM



Shaped in steel—here is beauty you can use as well as admire Spilled perfume and inks do not mar the enduring beauty of Sheet Steel furniture

Still he wouldn't believe it was Sheet Steel

It happened in a Pullman

Two men were talking about the safety of all-steel cars

"And notice the beauty of this interior," continued one of them

"Oh, this interior isn't Sheet Steel," returned the other "It's just the exterior and frame that's steel."

Even the conductor and the brakeman couldn't convince this man that Sheet Steel was under the beauty of the wall coverings, berths and furnishings

Yet Sheet Steel is used for products that require far finer workmanship than is demanded by Pullman Car interiors You will find Sheet Steel beautifully shaped—welded into the most graceful furniture for home and office Its great strength allows the designer to work unhampered Finishes can be baked on to endure through a lifetime of use These finishes resist spilled perfumes, ink, acids — even a lighted cigarette can burn itself out without a trace.

There are many products that can use Sheet Steel to advantage—to add enduring beauty, to reduce weight, to increase economy in first cost or in use. Manufacturers and designers should study the possibilities of Sheet Steel for use in fabricating their products An interesting booklet, The Service of Sheet Steel to the Public, *contains many suggestions. A copy mailed on request by the* Sheet Steel Trade Extension Committee, Oliver Bldg., Pittsburgh, Pa

MASTER TEC BRAND

This trade-mark stenciled on galvanized Sheet Steel is definite insurance to the buyer that every sheet so branded is of prime quality—full weight for the gauge stamped on the sheet—never less than 28 gauge—and that the galvanizing is of full weight and quality established by the Sheet Steel Trade Extension Committee specification.

Shaped in Steel

SHEET STEEL

FOR SERVICE

SCIENTIFIC AMERICAN

THE MAGAZINE OF TODAY AND TOMORROW

NEW YORK, AUGUST, 1926 — *Edited by* ORSON D. MUNN — EIGHTY-SECOND YEAR

CORRECT

SOME interesting sidelights were developed by our recent question as to the highest number that can be expressed by three digits. Many answers to this problem have been received, quite a number of them from well known mathematicians. Even these are not in entire agreement. The consensus, however, is that the correct answer is $9^{(9^9)}$, the equivalent of 9 raised to the 387 420 489th power, a number which would require over 27 years to write.

VELOCITY

HERE is another problem of a different kind. There is no "catch" in it. When the Chicago-Cincinnati-Pittsburgh Limited crashed into the stationary Pittsburgh-Washington Express, in Pennsylvania on June 17, killing some fifteen passengers, the two heavy locomotives of the moving train, backed by nine Pullmans, telescoped three steel sleeping cars their full length. These looked as if they had been ripped open by T. N. T. or by a giant can opener.

How does the energy delivered by this heavy train moving at 50 miles per hour compare with that of the shell of a sixteen inch U. S. Naval gun, striking at a velocity of 2 800 feet per second, assuming the train to weigh 1 200 tons and the projectile 2,100 pounds?

Before calculating, record your offhand guess or estimate—it will probably surprise you afterwards.

SOVIETS

WHAT a bizarre picture of conditions in the world of science in Soviet Russia one gets after noting sundry evidences that reach this country from the confines of that hazy pseudo-civilization. The Soviet government, having suppressed all public display of religion, is attempting to exalt science in its place. True, a little serious scientific work is now being done in Russia. In the meantime science lives in rags. "It was indeed a little embarrassing," writes a noted British scientist, after a visit to Leningrad, "to meet men of refinement and learning whose trousers were eked out with large and unrelated fragments."

The Soviets will find that elevating science is easier than extirpating religion. Science is based on the rational faculties, while religion is an emotion deeply planted in the human heart where it took root a million odd years ago, probably as magic. There is room for both religion and science. It is theology, not religion, which quarrels with science. History shows that theology always loses, always retreats somewhat, "digs in" again and absorbs more punishment. It never learns.

In This Issue

How Do They Know?

At the very same hour of an earthquake scientists the world over know when it happened, how far off and where. The interesting part of it is, they are practically always right. How do they do it? On page 90, one of them explains how simple it is.

Controversy

Lots of people find it difficult to convince themselves that the remarkably advanced Mayan civilization could have been originated by the American Indians. They must have borrowed it from the Old World. Dead wrong, say most authorities. On page 84 one of these authorities drives a spike in the Old World origin theory.

Science and the Golf Ball

A noted scientist has been putting golf balls through some revealing scientific tests. He finds they could be improved a lot—if science were called in to help. For example they could be made to drive farther. Will every player soon have golf balls built to his own specifications? See page 106.

Down in Davy Jones' Locker

How would you like to sit in a comfortable cozy little room at the bottom of a sunlit tropical sea, watching the fishes glide by and studying an ever varying panorama of coralline life? Read Dr. Miner's vivid narrative on page 87 and you will believe you have actually been transported to the bottom of the sea.

MORE THAN 200 PICTURES

Complete table of contents will be found on page 159

For Next Month

The Pole—"How Did Byrd Know He Reached It?"

The sun compass, the drift indicator and the bubble sextant guided him accurately. Very good, but how do these instruments function? Next month they will be explained and simply too.

The Oldest House in the World

A noted British archaeologist has discovered the wooden remains of a human habitation buried under strata of earth nearly a million years old. What this find signifies will be told in our September issue.

Next, the All-Metal Dirigible Airship

Government and other experts have been hard at work designing an all metal airship. Now it is about to be built for the Navy. Its completion may herald a wonderful advance. Read about it.

Other articles on, The Norfolk Islanders, The Level of the Great Lakes, The United States Lighthouse Service, Plants That Grow in Airtight Containers, A New Express Cruiser, The Gennadeion, The Sennar Dam, Conservation, Radio, Astronomy.

MORE THAN 200 PICTURES

DINOSAURS

ONLY the other day in passing through the reptile hall of the American Museum of Natural History we saw a headless skeleton of a dinosaur being moved to one of the great galleries. It was a weird sight to see this relic of ancient life being moved along gingerly by a modern electric tractor. The sight was so fantastic that we got our artist busy. On the cover of this issue you see the result.

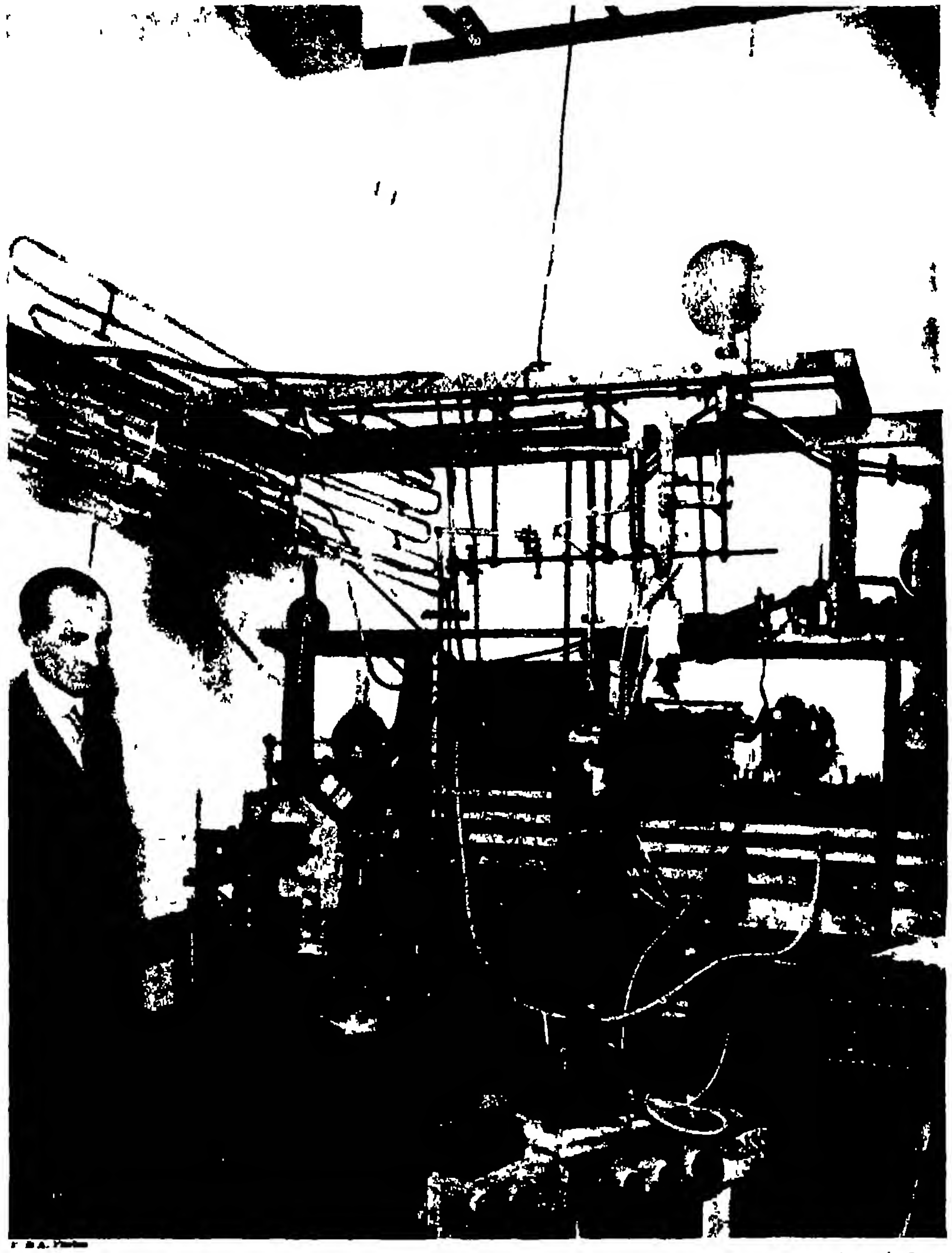
NONSENSE?

THE United States Chamber of Commerce says that American manufacturers are spending about $35 000 000 a year on research. This seems like quite a lot of money, especially since most of it sinks out of sight, at least for a while. But the Chamber also estimates that in the long run this same investment saves the manufacturers $500 000 000 a year!

The trouble is in most cases that it is a little hard to trace the savings back to the investment, the routes through which they are made being rather indirect. Thus the old time manufacturer either refused to throw away good money on such "nonsense" as hiring high-salaried men to play with a few test tubes of chemicals, or if he grudgingly spent a little on research he wanted to see the results at once. Nowadays, however, only a few hold out against the modern research trend. Research pays tremendous dividends.

WARNING

HAVE you ever noticed that the noise of a moving train is much louder when heard from the side than when heard from in front or back of the train? The reason is probably to be found in the action of the sound waves from the various parts of the train which interfere with one another as they flow away at right angles to the track less than when they pass down the length of the track. Recently a bus load of school children was struck at a railroad crossing. Although the driver stopped, stood on the track and listened, he was unable to hear the whistle of the approaching train although it had been sounded. Dr. Foley of the University of Indiana attributes this inaudibility to the interference of the dome and the smokestack, and it is suggested that the whistle should be placed before the smokestack and in front of a parabolic reflector to concentrate the sound and project it to the front. The idea is worth careful study and experiment by railroad officials, who are as anxious to avoid crossing accidents as are the drivers of motor vehicles.



P. & A. Photo

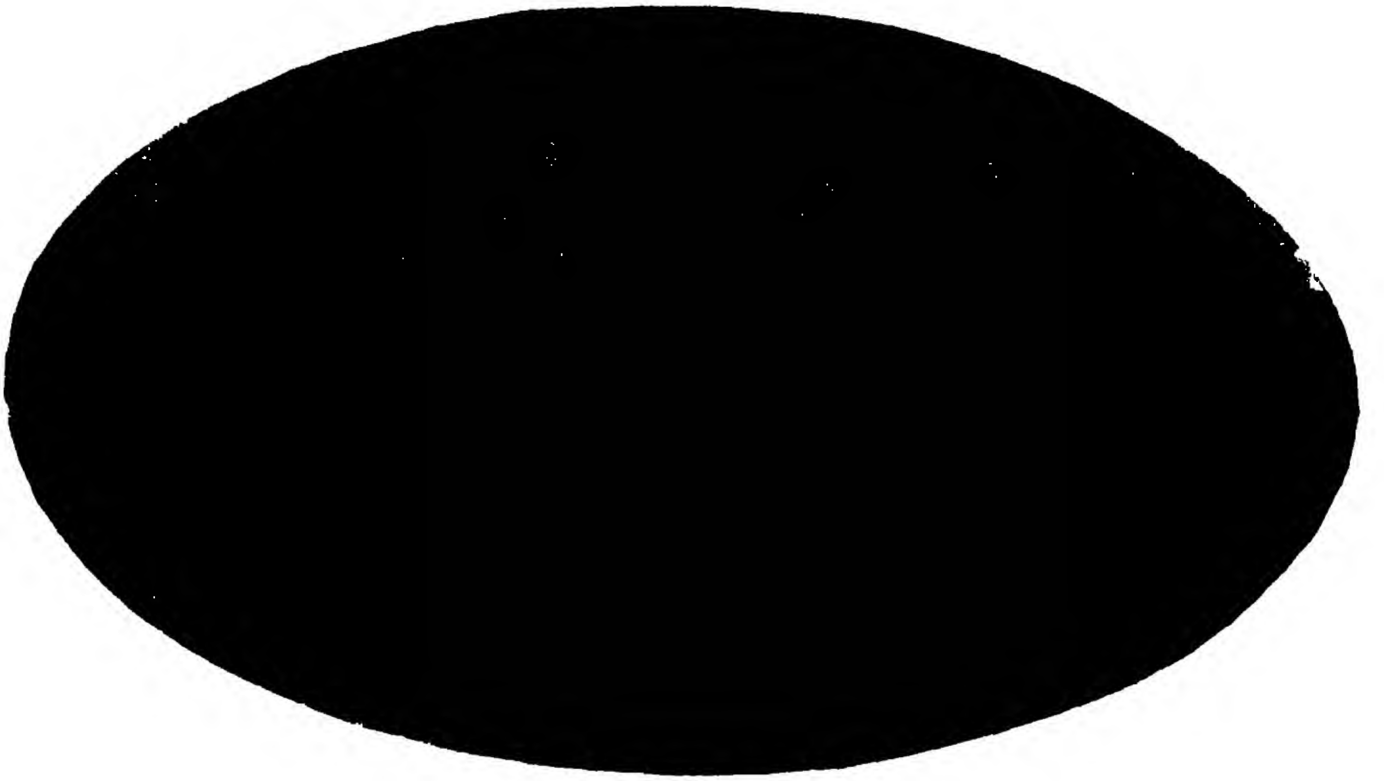
PROF B S. HOPKINS THE ONLY AMERICAN WHO HAS DISCOVERED A CHEMICAL ELEMENT

How Professor Hopkins of the University of Illinois recently discovered a new chemical element which he has named Illinum (from "Illinois") is one of the truest romances of science Professor Hopkins did not merely stumble on illinum, nor was the search an unguided venture Illinum had long been predicted Mendeleeff, a Russian chemist, had arranged the known chemical elements in a sequence which strongly suggested the number and nature of those which were still missing Moseley, a brilliant young British scientist whose life a fateful Turkish bullet extinguished at Gallipoli, formulated a rule which showed that element Number 61 had still to be identified In monazite sands which supply the rare earths used in gas mantles, containing elements Number 60 and 62, Professor Hopkins deliberately searched In the ultra-violet arc-spectrum of these rare earths he found the predicted lines that identified the previously undiscovered element, and X ray analysis confirmed his brilliant discovery

Wide World

Rebuilding the Roof of Rheims Cathedral

It was a conflagration, caused by shell fire, that did much, if not most, of the damage to Rheims Cathedral The outer timber roof was entirely consumed The old mediæval roof was built of massive rafters, heavily braced together Its purpose was to protect the stone groining (arched ceiling) from the weather. The sharp pitch of the roof was for shedding the snow freely. Here we see the new and lighter roof. Note the timber arches beneath every fourth rafter for carrying the load. This method provides a lighter and stiffer roof, allowing smaller timbers to be used.



THE WILLIAMSON UNDERSEA TUBE IN USE FOR SUBMARINE EXPLORATION

A Trip to the Bottom of the Sea

Hunting Coral and Studying the Living Beings of the Sea Floor In a Submarine Fairyland

By Ralph Waldo Miner
Curator of Marine Life American Museum of Natural History

THE American Museum of Natural History sends its explorers to many strange quarters of the earth. Early in 1921, it gave the writer the unusual commission of making a trip to the bottom of the sea to rob Davy Jones's locker of some of its treasures, so that a replica of a living coral reef might be erected in its new Hall of Ocean Life. Out of the way places still conceal many natural secrets, and expeditions have been undertaken to wrest them from desert and jungle and other inaccessible regions of our land masses but to penetrate the depths of the ocean and study the living beings of the sea floor is a task that presents its peculiar problems.

The Bizarre Fleet Sets Sail

However, most difficulties have their solution. So, about the middle of June of that year a strange fleet sailed out of the harbor of Nassau, in the Bahamas, bound for the remarkable coral reef that parallels the eastern shore of the Andros Archipelago.

The diversified vessels composing this fleet were strung out in a long line fastened to each other, stem and stern. First came the *Lady Cordeaux*, an ocean-going steam tug, belonging to the Bahaman government, towing behind her the *Jules Verne*, a peculiar looking craft, consisting of a barge with a long, low cabin surmounted by a turret, containing the Williamson under-sea tube, an ingenious apparatus for investigating the sea depths. Tied astern of this vessel was dragged a pontoon, consisting of two, narrow, box-like floats fastened parallel by cross-beams and spanned by a "scissors" derrick equipped with a ten ton chain-hoist. Next came the *Standard*, a forty-foot gasoline yacht, being towed to save motor fuel, while behind her were strung out two smaller but powerful motor boats, one of them a converted lifeboat, and two dinghies.

The sun was just setting as this remarkable procession rounded the western end of New Providence Island and steamed out upon the Tongue of the Ocean. This arm of the sea, which extends between New Providence and the Andros Archipelago, is a thousand fathoms deep, and is often lashed to fury by sudden storms. Under such circumstances the coral barriered coast to the westward is a deadly peril, and would have endangered our string of unwieldy craft, but fortunately on this night the full moon rose over a calm sea and flooded it with silver.

Our sixty mile voyage was made in safety and at dawn we were lying outside the entrance to Mangrove Cay. Close at hand the long line of snowy white breakers marked the location of the reef, while beyond, across the strip of quiet lagoon, stretched the low coast of Andros, plumed with coconut palms and rising above the dazzling white line of sandy beach.

At the lagoon entrance the *Lady Cordeaux* dropped the tow line and headed back toward Nassau. In the calmer waters of the lagoon it became the task of the good yacht *Standard* to take up the tow, aided by the smaller but energetic *Nautilus*. We were just in time, for now the trades began to blow in ever increasing strength as the sun rose higher. We could feel the force of the incoming waves as we sailed past the breaks in the reef, in navigating the channel of the lagoon.

At Mangrove Cay, beneath a spreading almond tree, we met the Commissioner of Andros, Mr. E. W. Forsyth, an Englishman of Bahaman birth, who rules over two thousand blacks in the name of the King of England. This gentleman courteously put himself at our disposal as guide to the tortuous channels and reefs of Andros. Through his aid and advice we took up our headquarters in the lee of a beautiful, verdure crowned islet known as Little Golding Cay, situated on the very line of the reefs, about five miles to the northwest of Mangrove Cay.

The sheltered side of this island boasted a crescent shaped cove with sandy beach, furnishing an admirable anchorage for our fleet. Here we established our work tents. The Museum men slept on the yacht and ate on the deck of the barge, on which was located our kitchen and the living quarters of our native crew of fourteen husky helpers.

In Cool, Waving Submarine Forests

The Museum expeditionary force consisted of the writer and three artists belonging to his staff, namely Chris Olsen, artist and modeler, Herman Mueller, a skillful modeler in glass and expert preparator of corals, and Dr. George H. Childs, a scientific artist. Last, but by no means least, we were accompanied by the well-known and ingenious expert on under-sea photography, Mr. Ernest Williamson, whose father is the inventor of the under-sea tube, the famous "hole-in-the-sea." This essential part of our equipment has been adapted by the son to motion picture photography, and, by the courtesy of the Submarine Film Corporation, of which Mr. Williamson is general manager, the entire outfit was put at our disposal under his personal direction, for the purpose of investigating the wonderful Andros reefs.

The outer side of Little Golding Cay is constantly assailed by breakers dashed against it by the steadily blowing trade winds, so that the exposed coral lime stone is eroded into fantastic pinnacles. Immediately seaward of the islet and to the north

and south stretch the reefs. At low water the branching tips of the living coral trees are visible just breaking the restless surface. By sculling perilously close to their serrated fronds in a native sponging boat it is possible by means of a water glass, to look down into the sea gardens through the tops of the stony forest.

The reef grows upward from a platform of coral detritus about fifteen to thirty feet below the water surface. This irregular sea floor shelves gradually seaward for a few hundred yards and then abruptly drops as a submarine precipice to the bottom of the Tongue of the Ocean six thousand feet deep. It was our purpose to study the outer side of the coral barrier from this submerged platform, as well as to obtain here the specimens needed for our museum reproduction of the reef.

Sitting on the Floor of the Sea

On the next comparatively calm day we towed the *Jules Verne* outside the reefs and moored it close to the front of a luxuriant portion of the barrier by means of an anchor with chain cable thrown to windward. This kept it from drifting against the reef. Two other anchors with heavy rope cables were carried out respectively to the north and south sides of the barge to keep it from swinging from side to side. Next the submarine chamber with its tube was lowered by means of a chain hoist through a well within the cabin, just under the tower already referred to.

The chamber is spherical in shape and about five feet in diameter with a plate glass window an inch and a half thick. At the top of the chamber is a circular opening to the rim of which is bolted the flanged bottom of the accordion-like tube through which entrance is gained to the chamber. This tube is built in sections made up of a succession of flat iron rings connected together by a double layer of collapsible hinge-like links of brass. Outside the links are alternate layers of rubber and canvas to completely exclude the water.

When the chamber was lowered to the required depth and all was in readiness we climbed down inside the tube using the inner edges of the rings as a ladder, until we entered the chamber. There two or three men could sit comfortably gazing out through the polished plate glass of the window at the wonders of the deep, just as if sitting on the floor of the sea.

It was probably the first time that scientific workers had ever looked at the outside of a barrier reef from the sea bottom and it was a sight never to be forgotten. We seemed to be looking into an enchanted forest of trees that had been turned to stone. They rose above our heads to a height of fifteen or twenty feet, their gnarled and twisted trunks giving place to densely interlacing branches, terminating in broad spreading fronds that pierced the water surface. Through the misty, tortuous aisles between their trunks could be seen other massive growths gradually melting into a pearly blue haze shot with beams of golden light made by the sun filtering between the branches above.

A SUBMARINE ARTIST AT WORK

In the bulbous end of the undersea tube there is plenty of room for an artist to work or for setting up a motion picture or other camera for sub-sea photography

The sea floor at the edge of this marble forest was a complicated tangle of prostrate trunks, overgrown and surrounded by the branching, spiked antlers of thousands of staghorn corals, while here and there graceful clumps of the more delicate finely divided fan corals gave a touch of fragile beauty to the scene. At intervals the forest growths gave way to open clearings, in which fantastic mushroom-shaped orb corals with stems as large as hitching posts, dotted the sea floor singly and in clumps of two or three, their round or conical caps mottled with green and brown. Between them the ocean bottom appeared littered with piles of golden nuggets as if a pirate ship had been wrecked here.

In reality these golden nuggets were nodular clumps of yellow *Porites* coral lighted into gold by the dancing sunlight which penetrated the constantly moving waves and unbelievably transparent waters to illuminate the bottom with surprising effect. Here congregations of magenta and yellow sea fans bowed and worshiped in unison, as the life giving currents from the open sea passed through their thronged multitudes, and sea plumes and sea bushes, brown, purple, and yellow, waved gracefully their finely divided and feathered branchlets.

And everywhere swarmed the fishes! Brilliantly blue *Chromis*, scintillating like sapphires in the sunlight, schools of angel fishes, changing from blue to gold, as they passed in possession from shadowed to lighted areas, butterfly fishes fluttering in black, white and yellow clouds, jacks, barred and banded, and blueheads, brilliantly blue anteriorly, but bright green as to the rest of their bodies, looking absurdly as if they had been cut in half and matched again wrongly.

A Two-ton Piece of Coral

Now and then a grotesque trumpet fish, eight feet in length, would sail majestically past, or a heavy bodied wide mouthed jew fish would glower at us from between the coral trunks. Occasionally, graceful shadowy forms of sinister appearance would appear at a distance, off at one side or the other, just to notify us that sharks were present, and then our attention would be attracted to the immediate foreground as a huge green or blue parrot fish would meditatively browse among the sea fans.

Suddenly the water surface was penetrated by a strange monster coated with silvery bubbles, which, continually released, flitted to the surface in glistening clouds. A grotesque creature with huge goggle eyes glided down to the bottom and advanced toward us with half floating strides, as though equipped with seven league boots. It was Williamson, diving helmet and all, who had suddenly plunged into our fantastic world, like the genius of the place. Through the round windows of his helmet we could see his cheerful face grinning at our surprise.

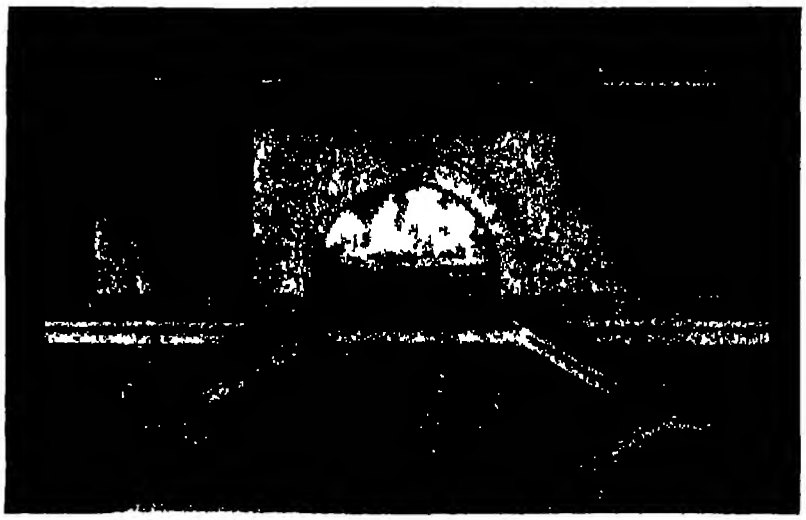
With leveled crowbar, like a lance in rest, he attacked a coral cluster, which fell at his touch. An iron basket, with rope attached, now appeared through the opaque, mirror-like surface film. This was soon heaped with choice specimens and hauled up to one of the motor boats, the bottom of which was visible above us. Larger specimens were tied to the rope, and jerked loose from the bottom. We now signed to Williamson to come near our window. By putting his helmet close to the glass, he could hear our voices. We pointed out a huge mass of palmate coral about twelve feet in length which we desired for the group. To secure this seemed a problem which was finally solved as follows.

The pontoon with the chain hoist was anchored immediately above the coral tree, and a chain was

Photographs courtesy the American Museum of Natural History

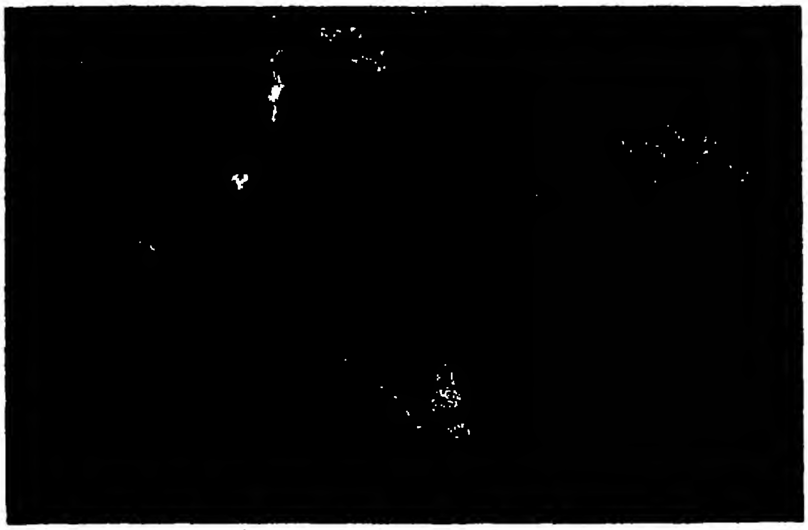
THE SPOILS OF THE SUBSEA EXPLORER

A strongly constructed derrick supported by two pontoons enables the explorers to raise huge pieces of coral and other specimens to the surface for future study and use



THE BEAUTY OF A CORAL BED CAPTURED

A small model of a natural size reproduction of a coral bed and its attendant sea creatures. It will soon adorn a section of the American Museum of Natural History



IN AN UNDER WATER PARADISE
Here a diver is fastening a cable to a coral group so that it can be broken from its resting place and raised to the surface by means of a large floating derrick

DESCENDING TO THE OCEAN DEPTHS
The opening of the Williamson under sea tube through which the explorers passed when going down to the chamber from which under water activities were studied

lowered to Williamson, who fastened it about the trunk beneath the larger branches A signal to the man on the pontoon, and the chain was pulled taut A few minutes' wait and the next incoming wave lifted the pontoon and wrenched the coral loose, as if with a giant hand It was then hauled to the surface with the hoist and placed on timbers arranged across the pontoon Later it was found to weigh approximately two tons! In this way, during the next two weeks, specimen after specimen was secured and towed to our sandy beach on Little Golding Cay Here they were bleached by Mueller, assisted by natives Soon the shore was decked out in fantastic array with hundreds of snowy coral treasures, while between our tents were strung long lines of vari colored sea fans and plumes drying in the breeze

There were many days when we could not work outside the reef because of the strong trade winds, which drove huge rollers against it At such times we lowered the tube in a quiet channel of the lagoon to investigate some beautiful isolated clump of coral or sent our half stripped native divers to the bottom for choice specimens Our artists, Olsen and Childs, placed these in a large aquarium which we erected on the beach, and sketched their living colors

On one occasion, however, we grew impatient, and although the sea was a little rough for comfort, dared the tube outside the reef As we sat in the chamber, desperately photographing and sketching, and operating the moving picture camera, our spherical room bobbed and tossed with the pitching of the barge overhead We had much ado to keep upright as the chamber banged and battered the coral heads, and broke the mushroom orbs from their stems Finally we were forced to abandon our work lest some projecting stony branch should crash through our glass window

Meanwhile the sea had continued to rise so that it was difficult to raise the anchors of the barge and at the same time prevent her from being driven on the reef To cap the climax one of the anchors caught on a ledge So, much to our chagrin, we had to cut the cable and leave a perfectly good anchor as a memento for the mermaids We were then towed two miles out, in order to turn in plenty of sea room, while the crew of the barge worked like demons to raise the submarine chamber and secure it in its tower Finally we drove straight in, ahead of the wind, negotiated the narrow channel, and were soon quietly anchored back of our islet

Solving the Transportation Problem

One evening we had an adventure with a shark A crew of men were going ashore in the motor life boat for water It was about five o'clock and several sharks had been seen coming in from the open sea One of the hungry monsters apparently mistook the bottom of the boat for a fish, and the moving propeller doubtless convinced him, for he made a swift dash for the stern, where, caught by the propeller, he was thrown completely out of the water and dropped back, bleeding from a huge gash under the jaw He turned over two or three times in the water and disappeared in a pool of his own blood

' ' the rudder was unshipped and the engine was stopped Everyone in the boat felt the shock, and when the engine was started again, it was found that the propeller shaft was sprung and the stuffing box leaked. As we had no way of mak repairs, this boat was useless as a motor for rest of the trip, although it could be towed about as a freight boat

Our collection of corals soon became so large that the problem of packing was a serious one It was all the more puzzling as we had no lumber and we needed soft packing to keep our heavy, fragile treasures from breaking in transport So we sent native sponging vessels back to Nassau, whence they returned loaded to the gunwales with Georgia pine As for packing material, we discovered a sponge house hidden among the coconuts at Mangrove Cay, where we could secure sponge clippings by the boat load These were ideal for our purpose

The beach was turned into a carpenter shop, as we built cases around the larger specimens, which we lashed securely in place, packing the smaller heads and clusters into the interspaces, the whole being bedded and buried in sponge clippings When everything was finished, we had 31 cases of corals, some of huge size, and an equal number of boxes of equipment

We used 2,000 feet of lumber, ten boatloads of sponge clippings, and two bales of burlap All was then loaded on the barge, pontoon, and boats, and we were ready for the *Lady Cordeaux* to tow us back to Nassau She was due the next day, by appointment made via a native sponger, and before daybreak her lights appeared off the reef Our cargo was speedily towed out to her and transferred to her capacious decks by her powerful derricks. That night we returned as we had come, by full moon on a calm sea, and by dawn were calmly resting in the harbor of Nassau, whence our cargo was safely transported by liner to New York

We had been away from the Museum but eight weeks, and we had returned with forty tons of coral for the new exhibit, for which we had important observations from life on the sea bottom, as well as 1,500 photographs, of which many were secured under the sea There were also 2,000 feet of motion pictures, and more than 60 water color sketches showing the colors of the living corals

¶ Descended from a mixture of English and Polynesian stock the residents of Norfolk Island are an interesting race Their striking physical and other characteristics will be detailed in our September issue by Dr H L Shapiro

PALMATE CORALS
The broad branches of this West Indian coral sometimes reach a height of fifteen or twenty feet

CORAL AND STAGHORN
cate symmetry is at the left while the nd is at the extreme right

Guesswork—or Science?

The Method By Which the Scientist Locates Distant Earthquake Sources Is Surprisingly Simple in Principle

By Francis A. Tondorf, S. J.
Director Georgetown University Seismological Observatory

THE more reliable of chronologists have computed it is probable that man has tenanted this isolated globe for some well nigh nine thousand years. Yet no steel has been tempered hard enough nor edged sharp enough to fluff more than a scratch on the planet's surface for the geologist to peep into.

Petty then as is our knowledge of the earth's interior, of one thing we are quite certain and this is that from the very first consolidation of the crust the earth apparently fretful at its very existence betrayed this anxiety in persistent tremblings.

When people became witness to these uncanny happenings they instinctively set themselves to ferreting out what all this might mean. Particularly concerned were they to ascertain when a recurrence was likely to take place. Naturally right here earthquake researches took a footing.

But science without the machine is an anomaly. According to we find that as far back as 136 A.D. (this we learn from the Chinese annals) a Chinaman Choko by name and by trade a smith worked out of a lump of copper an instrument for recording the tremors of the surface of the earth. To this mechanism he or one of his admirers gave the name of "seismoscope."

Originated in Japan

The Chinese annals describe this assemblage of materials as follows: "The machine consists of a spherical copper vessel the diameter of which is eight feet. It is covered at its top and in form resembles a wine bottle. In the inner part of this instrument a column is so suspended that it may move in eight directions. On the outside of the bottle there are eight dragon heads each of which holds a ball in its mouth. Underneath these heads are eight frogs so placed that they appear to watch the dragon's face so that they are prepared to receive the ball if dropped. When an earthquake occurs and the bottle is shaken the dragon instantly drops the ball and the frog which receives it vibrates vigorously. Any one watching this instrument can easily observe earthquakes."

Remarkable enough in spite of the demand no instruments were thrown into competition with this unique contraption of Choko until the year 1703 when De Haute Feuille, a French abbé, slightly modified that of our Chinese friend. From then on quite a few machines were marketed but of these it can truthfully be said that they in nowise lent themselves to a quantitative assay of the earth's tremblors.

Just a trifle over forty years ago a quintet of English geologists by name Gray, Perry, Milne, Shaw and Knott made their way to Japan where earthquakes grow over night and there in collaboration with the native geophysicists assembled the first of the scientific seismographs.

> **A Scientist in a Cassock**
>
> **You read in your morning paper that a severe but distant earthquake shock has been recorded by instruments situated at some observatory. The shocks came from some as yet unlocated source, let us say, 6,500 miles away. Before the next edition of that newspaper has been issued the exact spot where the 'quake occurred becomes known. How? This is what the editor requested Father Tondorf to explain.**
>
> **Father Tondorf is a priest of the Society of Jesus—the Jesuits. He is also a seismologist of note, being well-known for his researches on earthquakes. His description of the method by which 'quakes are located shows that this is not so complicated a process as many people assume.**

A seismograph as its Greek name indicates is nothing more than a simple writing machine. To be true to its coinage it is bonded to deliver as accurate a script of the earth's every movement as is possible. Every child who has made his initial bow to the three Rs is aware that for writing there are three requisites—paper to write on, a point to write with, and a steady guiding hand. The paper and writing point these are within easy reach but the steady hand for the seismograph there seems to be the crux of the matter. However this difficulty is one more or less of fancy.

Many years ago, Sir Isaac Newton, he who stumbled on the laws of gravity on noticing an apple tumbling from a tree (so the story is told) wrote a book, under the title "Principia Mathematica." In this book amongst other things, he pays a very uncomplimentary compliment to matter. He brands it as 'lazy,' although in order to say it politely he used the Latin word *iners*. Thereupon he proves it. He adds: "Every body perseveres in its state of rest or of uniform motion in a right line, unless it is compelled to change that state by forces impressed thereon."

This embodiment of passivity in matter will fill the bill. Hook a point to lazy matter and let the paper prance beneath it with the prancing earth and the seismogram is written.

Unfortunately it is that every body is in somewise bound to the earth and therefore that an unchanging state of rest is an impossibility. But in the proper suspension of the mass where the friction is reduced to a minimum this vitiating element is greatly eliminated. It is just a case of getting the best we can.

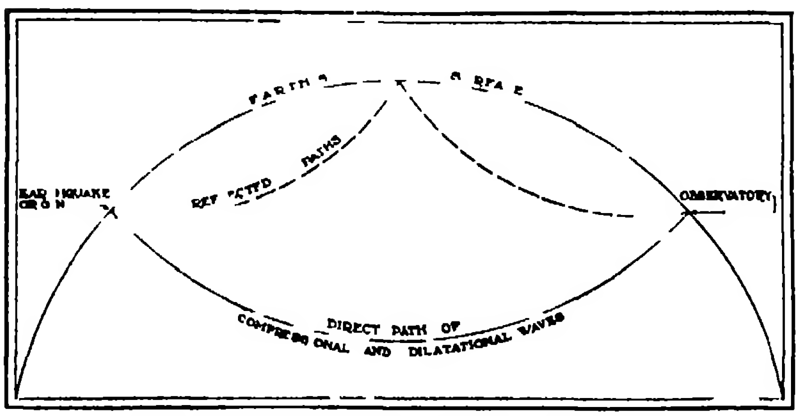
Now that the reader has been introduced to the seismologist's amanuensis he should know something of his product. An exhibit therefore, of a sample seismograph written by this bulky amanuensis is in order.

Earth's Topography Continually Changing

Uniquely enough Mother Earth is ready at a moment's notice to flash her signal of distress to every nook and corner of the globe. This she does through a train of elastic waves which in her fretfulness she bids hie their way along the shortest lines through the earth's crust. It will be noted how cleverly each of these wavelets is transcribed in the accompanying graph of the quake of February 28, 1925 which had its center in the region north of the St. Lawrence and south of the Saguenay Rivers and was sensibly felt throughout Canada and the entire eastern section of the United States. Particularly emphasized are the grouping of these undulations each in turn specific yet none repeating itself.

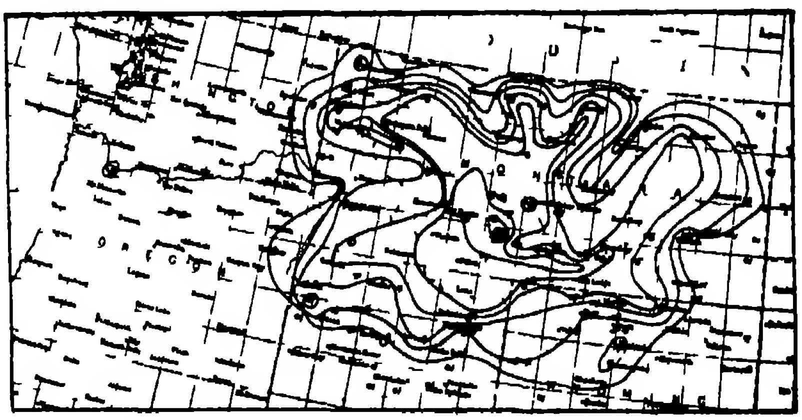
A skin deep analysis of this script cannot but convince one of the skill of the scribe and at the same time awaken a curiosity to know what scientific information might be coded in these alternations of ups and downs in black and white.

It is the unanimous verdict of geophysicists that all earthquakes excepting those that take their origin in volcanic eruptions are limited in their occurrences



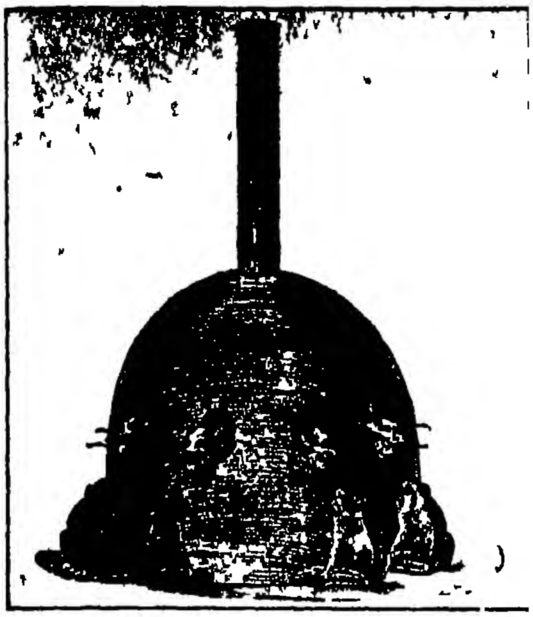
HOW EARTHQUAKE SHOCKS TRAVERSE THE EARTH

From the point of origin waves pass both through and around the earth at previously known velocities. With this information finding the source is simply algebra



THE QUAKE THAT SHOOK MONTANA JUNE 27 1925

The lines are those of equal intensity. By this method it is possible to locate the point of origin which is always below the surface of the earth



ANCIENT CHINESE SEISMOSCOPE

...teen hundred years ago a Chinese investigator made unique indicator. When a 'quake occurred the dragons dropped balls into the frogs' mouths

to areas of geological weakness. They are no less agreed that the topography of our planet is continually changing. Mountains are seeking the level of the sea bottoms, and sea bottoms are stretching skyward. These alternations give rise to stresses which are felt throughout the substance of the earth's structure, and sooner or later bring about fractures in the abutting zones of weakness.

Gigantic compression and distortion of the rock material follow in the wake of these breaks and from their seat, compressional and distortional elastic waves rush to the steel scribe to voice their word of protest. Interpret the arrivals of these waves at C and B in the record and you have already read much out of the monograph.

In the point of arrival it will be noticed that the compressional wave has outrun the distortional by eight seconds short of two minutes, the minutes being noted by successive indents on the line of normal travel of the 'gram. As the relative velocities of these waves are 497 and 279½ miles a minute, the computation of the distance from this lag in time is within the reach of a child of the graded schools. The problem may be thought of in this fashion: given the time of arrivals of two trains running between New York and Boston, with the trains ... ng on parallel tracks and at the above velocities, solve for distance between these t...

As the determination of the geographical position of an earthquake is the seismologist's chief concern it must be clear that although the distance may be figured out from a respectable seismogram to within a very few miles, this by no means dispatches the problem. The missing elements are the latitude and longitude of the center of disturbance. To ascertain these the cooperation of other observatories is imperative. At least two, preferably more, stations are chosen, so located that arcs drawn with radii equal to the computed distances of the quake from these several stations will bring the arcs into intersection. This intersection fixed the required coordinates are fixed.

Seismology Still in Its Infancy

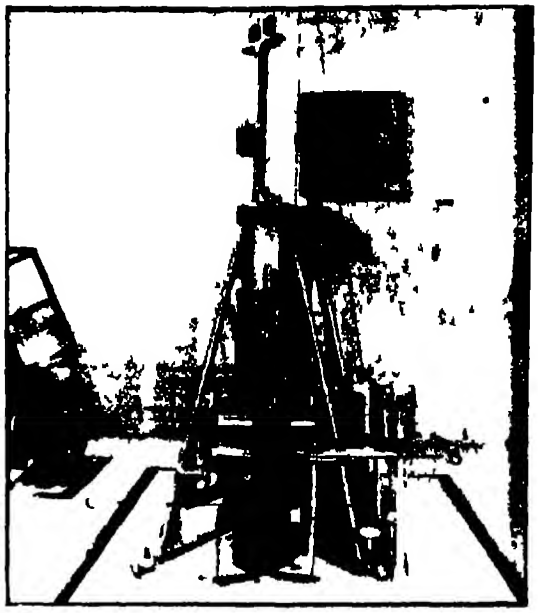
In cases where the epicentral tract defined by Mallet as the pro...
displacement upon the surface is near at hand easier methods although only approximate for the determination of the focal point of the quake are available. The method which depends on observations of equal intensity distribution deserves note because of the possibility of its application to earthquakes of all degrees of strength. On the basis that as the result of a shock at a point in a homogeneous medium, we ought, theoretically, to obtain at points on the surface of the medium equidistant from the epicentrum, equal mechanical effects, these effects are tabulated over the entire affected area of the 'quake in terms of dislodged loose objects, fractures in buildings and so on, and this in turn is tabulated in terms of the intensities of these dislodgments and fractures. The points of equal intensities are then interconnected by so-called isoseismal lines.

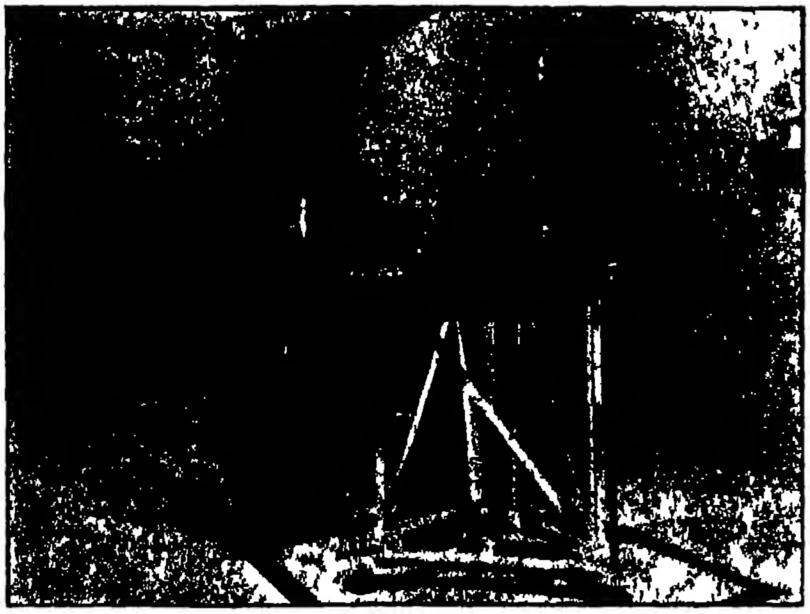
These lines so plotted, will be found to crowd in towards a common area known as the meisoseismal area, the area of greatest disturbance. The map of the 'quake of June 27, 1925 (presented herewith) drawn up by the United States Coast and Geodetic Survey indicates the focal point as determined by the isoseismal lines. This center actually measured up closely with that determined by the method of arcual intersection.

The science of seismology is still in its infancy. The promise, however, of an early maturity is encouraging. Today a chain of earthquake observatories encircles the globe and it is interesting to know that no fewer than thirty links in this chain are scattered over the United States. In this fact lies the assurance that a close check will be maintained on the thousands of 'quakes which, according to Dr. Sieberg of Jena, Germany, occur annually in the whole earth.

Such agencies as the British Association Seismology Committee, the International Seismological Society, the Imperial Earthquake Investigations Committee, the Seismological Society of America, the Carnegie Institution of Washington, the Geophysical Union and the National Research Council are stimulating researches on earthquakes by material assistance. The several governments of the world have likewise subsidized these investigations. So our own government has recently authorized the conduct of similar work and has designated the Coast and Geodetic Survey to execute it.

Thus we are assured of the continued activities of the Nestors in seismology and the newer attempts of an enthused younger generation of geophysicists. These, we are confident, will teach us to read much more out of the seismogram than we have read before and will help clear up the mysteries of the fretful earth.





IN THE SEISMOLOGICAL OBSERVATORY AT GEORGETOWN UNIVERSITY

Three seismographs of the horizontal type, the Bosch-Omori, the Mainka and the Weichert types—are included in the equipment. The floor does not touch their bases at any point

THE GREAT QUEBEC EARTHQUAKE WRITES ITS TREMBLING SIGNATURE

At C the compressional wave arrived. Two minutes later the distortional wave came in. From these records the distance to the disturbance was found. At A the pen left the sheet

Our Point of View

City Planning

THIS is an age of committees, especially in matters of municipal administration. When a city wishes to have a thing done, it forms a committee, and always the committees seem to be about four or five times as large as they need be. The latest example of this is the Mayor's Committee on City Planning and Survey. In one of the seven sub committees, we are told, there are no less than 70 people.

Personally, we are of the opinion that if you can get hold of the right man there is nothing more effective than a committee of one.

We are now speaking of New York City, and the committee referred to is known as the Mayor's Committee. In what we have said, we do not wish for one moment to be understood as criticising the move of our Mayor to straighten out the tangles, relieve the congestion of the city and reduce its chaotic conditions to a system that will be workable and economical, and will relieve the many distresses into which the citizens have fallen. Mayor Walker is doing what should have been done years ago.

It may be true, as was said of old, that "In the multitude of counselors there is wisdom," but equally true is the modern and sententious statement that "Too many cooks spoil the broth." We think that an ideal committee or sub-committee would be one composed of an engineer, an architect, a technically trained traffic man, and a physician, each of them highly expert and with long experience behind him. The make up of these sub committees might be varied, probably would have to be varied, to cover the particular section of the city planning involved, but no one who has had experience in committee work will deny that four or five competent men will get more work done with less talk in a day, than a committee of 70 will accomplish in a week or a month.

Preventable Slaughter

FREQUENTLY, as the history of engineering progress proves, it has required some great disaster involving large loss of life, to bring about improvements, particularly those which are designed to protect life and limb. It took the *Titanic* disaster to force upon shipbuilders a better system of bulk heading and a more complete equipment of life boats.

Let us hope that the recent ghastly rear collision between two Pennsylvania Railroad express trains will hasten the day when all railroad tracks that carry frequent and fast traffic will be equipped with that perfect protection against such disasters—the automatic stop.

Previous to the introduction of this device, the greatest protection against rear-end collisions was the block signal system under which no two trains can be within the same block at the same time. The block system, however, is defective in so far as it depends upon the human element, which, as this recent accident has shown, may suddenly cease to function. The block signal system, considered as a piece of mechanism, is a perfect device for its purpose of preventing collisions, but since it is absolutely dependent upon the clear eyesight, close attention and instant obedience of one man, the engineer, it is to that extent a faulty system, as the recent wiping out of 15 lives and the wounding of 75 people so gruesomely prove.

The automatic stop eliminates the human element. It enables the block signal to lay its hand directly upon the throttle and the air brake valve in the engineer's cabin. He may be inattentive, asleep, or dead, but if the semaphore arm says "stop," the electric impulse that lifts that arm will also take hold of the control mechanism of the engine and the train. The automatic stop is not a new and untested device. For nigh upon 20 years it has been guardian of the lives of the scores of millions that have traveled over the subway tracks in this city, almost from the time that they were first put in operation. Although the express trains have a speed of 40 miles an hour, and follow each other with an interval between them of less than two minutes, rear collisions never occur. Were it not for the automatic stop, there would have been a terrible list of fatalities, for the trains at times overrun the trip and are stopped. As matters stand, in respect to the number of people carried within a given time, and with a given frequency of trains, we venture to say that there is no railroad in the world whose record approaches that of the New York subways.

And it is the automatic stop that has achieved this.

The Pennsylvania Railroad system has for many a decade been considered one of the finest, best-equipped and best run railroads in the world, but occasionally on this, as on other of our finest railroads these fatal rear end collisions occur. The Interstate Commerce Commission has ordered over 40 of our busiest roads to install the automatic stop and they are at work upon this very costly undertaking. Were it not that the Interstate Commerce Commission has been setting the screws altogether too tightly upon the railroads—so tightly, in fact, that only one or two of them, are able to earn the six percent minimum of interest which the Interstate Commerce Commission considers to be only just and fair—the roads would be earning sufficient profits to be able to put in the automatic stop faster than they can ever hope to do under existing conditions. Whatever may be said about the early history of the railroads, there is no denying that during the past 25 years, and notably since the War, the Interstate Commerce Commission and the public at large have been dealing most unfairly with the railroads. No one is more eager to prevent collisions, to safeguard the lives of the passengers than are the able and far seeing men who today are at the head of our great railroad systems. They should be given a chance to show what they can do.

For Safer Planes

The aeronautical world has been placed under great obligation to Daniel Guggenheim for his princely gift of $10,000,000 to be devoted to the development of Aircraft for general passenger and commercial travel. That the money will be spent to the best advantage is suggested by the recent offer from the fund for the Promotion of Aeronautics of prizes totaling between $150,000 and $200,000 for inventions that would increase the safety of flying. The lack of public confidence in the safety of flying is the greatest handicap to the development of passenger-carrying service on a commercial scale.

We are heartily in sympathy with this point of view. More than anything else, it is the daily record of deaths through the fall of airplanes out of control that is holding back the public. These perpetually-occurring disasters must be stopped if we are to get the American public into the air in any paying numbers, and the only way to eliminate them is by the invention of devices which will render the planes themselves inherently stable, and will enable them to regain control of themselves when stalling occurs.

Europe is far ahead of the United States in such devices. The Handley-Page slot and the Tailless airplane of which a full description and discussion by Professor Klemin appears on page 143 of this issue, have proved that the problem is capable of solution.

An Indictment of the Skyscraper

WHEN the original plans of our cities were drafted, the width of the streets was determined—if any thought was given the matter—by the expectation that they would be lined with buildings of from five to six stories in height. As long as the buildings, particularly in the business section, were restricted to such heights, there was little, if any congestion on the streets such as we experience today. But as the buildings began to increase in height, and notably after the introduction of the skeleton steel office building, street congestion both of pedestrians and vehicles, began to make itself felt. Today, there are long stretches of streets in some of the larger cities where from an average height of five or six stories, buildings have risen to an average height of 15 to 18 stories, with not a few structures that rise 25 and 30 stories. As between a five story and a 30-story building, the floor space has been increased six times, that is to say, during the rush hours or at the noon hour, there are six times as many people discharged on the section of street on which the building fronts as there were under the old conditions.

We are aware that it is something like sacrilege to say anything against the modern tall building—so greatly has it been lauded on the ground of its impressiveness and magnificence, and even of its aesthetic and artistic appeal. Thus, the traveler from abroad, when he catches his first glimpse of lower Manhattan, breaks into exclamations of wonder, and in the case of some of the artistic brotherhood, it has often been spoken of as ethereal. Well, all this may be true, when from the waters of New York Harbor or Lake Michigan, you see the skyline of Manhattan or Chicago. But when the traveler lands and finds himself jammed up in a mass of automobiles at a street corner, or jostled in a mass of city workers upon the sidewalks, he begins to realize that there are other problems of a very serious nature attending upon these *Gargantuan* structures.

We are suffering from congestion which is largely due to the exaggerated height of our skycrapers. Congestion must give way to distribution. If we are to have tall buildings, there should be only so many of them permitted to the city block. Judging from the present conditions and looking to the future, it must surely be realized that the mere building of new subways can never keep pace with the unhindered erection of these buildings each housing a population of a town of respectable size.

AN EXAMPLE OF ART

This bronze lion head of semihuman type is typical of Roman skill. It is but one of the ornaments rescued from one of Caligula's galleys now resting at the bottom of Lake Nemi

REMAINS OF THE TEMPLE OF DIANA

This temple was once associated with the sunken galleys of Caligula. Here were celebrated grim, mysterious rites. Excavations on this site were begun by the late Lord Savile, formerly British Ambassador at Rome

ROMAN METAL-WORK

This bronze head, suggesting the wolf of Romulus, is but a token of other treasures to be reclaimed from the galleys which have resisted every effort to raise them from the lake

Raising Caligula's Sunken Galleys

Nineteen hundred years ago, on the banks of Lake Nemi, a picturesque little lake in the Alban hills near Rome, stood the famous sanctuary and grove of Diana. It was to this pleasant refuge and to his magnificent floating galleys anchored there that the Roman Emperor Caligula repaired for an occasional respite from his life of crime in Rome. These houseboats were beautiful beyond our dreams, incrusted with marble, ornamented with precious metals and scented woods and adorned with statuary; the sails were of the finest linen and the hangings were embroidered with silver and gold.

Now, these rich old galleys lie at the bottom of the lake, where their outlines can be faintly seen on clear, still days. Repeated efforts, which date back as far as the Fifteenth Century, have been made to raise them—but all have been futile. In 1895, divers brought to the surface wooden fragments, magnificent bronze ornaments, curious relics and information concerning the structure of these vessels.

The most recent suggestion for their recovery has been to drain the lake for a temporary period by means of a tunnel or tube of discharge, to be filled and entirely stopped up at the end of the enterprise. The reclamation of these galleys would bring to light a marvel of naval construction and the highest expression of luxury.

BRONZE HEAD OF MEDUSA

This and many other elaborate ornaments not yet recovered from the sunken pleasure boats—metals, ceramics, terracottas, mosaics, altars, fountains, statues—are all indicative of the dazzling splendor which once was Rome's

A BRONZE LION HEAD

This was on one of the galleys. All kinds of curious relics have been brought up by divers. The late Lord Savile in 1885 made the first excavations in the temple of Diana on the shore of Lake Nemi, near the galleys

All photographs courtesy of the "Illustrated London News"

A BRONZE *TRANSENNA*, OR SECTION OF BALUSTRADE

Although it has lain at the bottom of Lake Nemi for 1,900 years, it does not seem to be much impaired. Divers were able to draw a plan of the parts of both ships and to establish their dimensions. The larger one measures 231 feet in length by 78 feet in breadth

AN AUGURAL HAND IN BRONZE, ATTACHED TO A BEAM

The vessels are still fairly well preserved. The one nearest to the shore contains in the hulk all the machinery and the costly ornaments of the deck. It was certainly because of the enormous size and weight of these floating palaces that they did not remain long afloat

The Testimony of the Jades

The Failure to Locate the Source of the Jade Used by the Maya Indians Does Not Prove that the Mayan Civilization Was an Old World Importation

By Henry S. Washington

Petrologist at the Geophysical Laboratory of the Carnegie Institution of Washington

ANTHROPOLOGISTS now generally hold the opinion that the American Indians are not autochthonous—native to the soil—but that their ancestors came from northeastern Asia, crossing on the ice jams in Bering Strait, or by a then existent land bridge where is now the shallow Bering Sea. From the Alaskan region they gradually spread over both American continents.

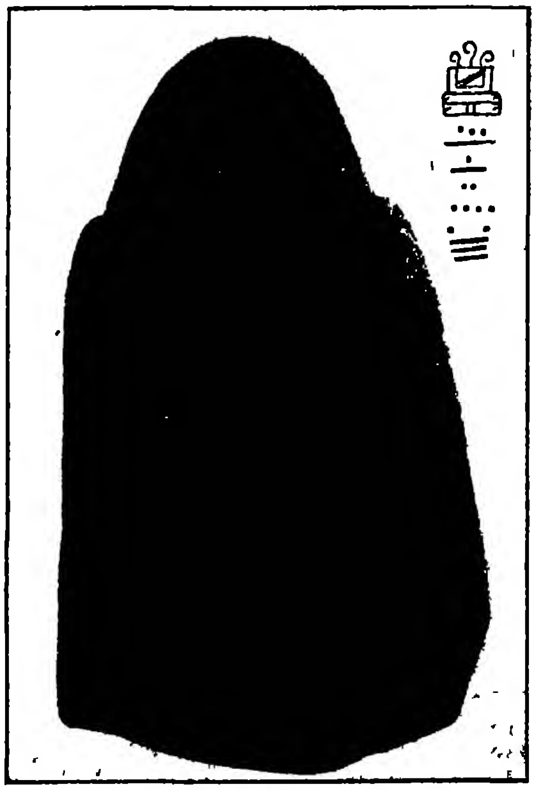
Most of the tribes scattered over North and South America, advanced scarcely beyond the hunting, or in some cases the agricultural, stage. But there developed in Middle America—a term now used to denote Mexico and Central America—a comparatively high state of civilization, as among the Aztecs and Toltecs of Mexico and the Maya of Central America.

In order to account for this remarkable local development, the hypothesis has been advanced that the culture of the peoples of these regions was modified by the influx of inhabitants of southeastern Asia, who crossed the Pacific in canoes, probably driven by storms, and who brought with them, and introduced among the Middle American tribes, something of their own culture, including jade.

Whence Came the Mayan Jade

This hypothesis rests largely on two arguments. The first is the similarity between the architecture of the Aztecs and Maya and that of Cambodia, Java and neighboring districts; with this aspect of the problem we have nothing to do. The second argument is that jade, regarded as one of the most precious of precious stones among the Middle American Indians, is not found in place—that is, as a natural occurrence—anywhere in Mexico or Central America, although it has been searched for, while it is regarded as precious in southeastern Asia and is there found native. It is to describe American jade and set forth briefly some serious objections to this second argument that this article is devoted.

First of all: What is jade? The name is applied to the massive form of two different minerals, which, however, are much alike in their general appearance and other characters. Two scientific names—*jadeite* and *nephrite*—are used to distinguish these. Without going deeply into mineralogical technicalities, it may be said that jadeite belongs to the pyroxene group of minerals and, chemically, is a silicate of alumina and soda, whereas nephrite belongs to the amphibole group and is a silicate of lime and magnesia, often with a little iron oxide.



THE TUXTLA STATUETTE, DATED 96 B. C.

FIGURE 1 *Did the jade come from Asia, or Mexico?* INSERT: *The Mayan characters for 96 B. C.*

The two differ in other than chemical ways. Thus, jadeite jade is usually granular in structure (Figure 2) and is comparatively brittle, while nephrite jade is seen under the microscope to be a densely matted felt of minute mineral fibres (Figure 3). This texture renders nephrite jade extremely tough—much more so than the other.

The story goes that a dealer in minerals, who wished to break a piece of nephrite about the size of the two fists, placed it on the anvil of a large steamhammer used for forging steel. When the hammer fell, the anvil, not the jade—broke.

Another difference between the two is the specific gravity, that of jadeite being between 3.0 and 3.3, while the specific gravity of nephrite ranges from 2.9 to scarcely over 3. This difference furnishes, in many cases, the best means of distinguishing between the two minerals without injury to the object.

There are also, as a general rule, decided differences in color between the two. Jadeite is usually white or light green, and is often mottled green and white, while most nephrite is of a dark, somewhat yellowish, green. But white, jadeite-looking nephrite occurs, and some jadeite has the peculiar, dark green color of nephrite, so that these color distinctions cannot always be relied on. Jadeite is slightly harder than nephrite.

Both kinds of jade are capable of taking a very high and lasting polish, and the polished surface of both has a peculiar "feel," a character that is evident to the expert, and which is one of the charms of the material for the Chinese, or other, collector.

The high esteem, almost veneration, in which jade was held by many diverse, widely scattered, primitive peoples is very remarkable. Its recognition in the rough by the early prospectors is equally so. Jade, found or used in the earliest times only as water worn stream pebbles, is, in the rough, mostly of a dull color and not especially attractive.

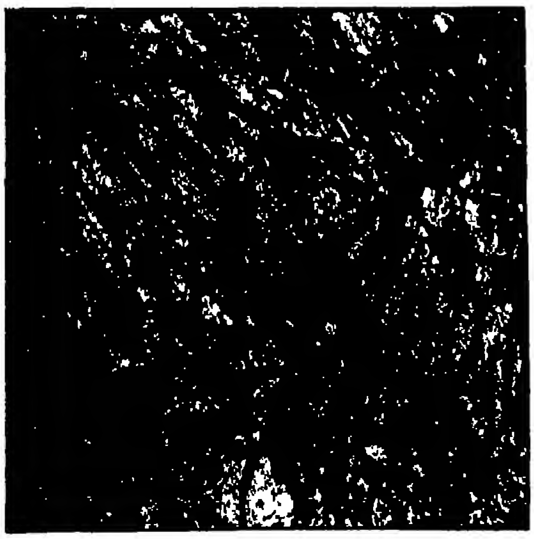
It seems probable that the use of jade came in with the introduction of the art of grinding and polishing stone tools and weapons at the close of the Paleolithic or the beginning of the Neolithic age, about 7,000 to 10,000 years ago, according to Professor Henry Fairfield Osborn.

Scouting the Asiatic Theory

Before the art of grinding chipped stone was known the unchippable jade pebble was discarded by the Paleolithic workman, whereas his Neolithic successor, attracted possibly by the green color or by some surface peculiarity, applied the new method to it. Jade was discovered, and quickly became the mode. The pleasing and unusual colors, the difficulty of working it, its toughness and high polish, and the comparative rarity of its occurrence, gave jade a preeminent value, so that it became one of the most precious of early man's materials for ornament—a position that it held for thousands of years.

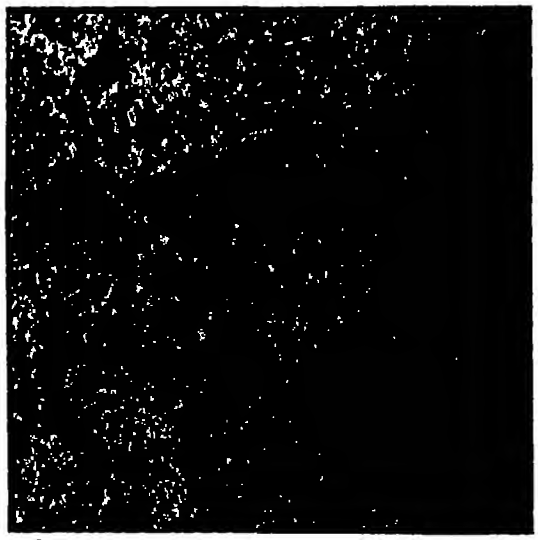
And now to return to our Aztecs and Mayas. The jade-based argument for the coming to Middle America of people from southeastern Asia, it will be seen, depends on two chief postulates: (1) jade does not occur in place in Middle America, and (2) the material of the jade objects found in Mexico and in Central America is identical with the Asiatic material.

It is true that, so far, no jade, whether jadeite or nephrite, is known to occur native in Mexico or Central America, not even as stream pebbles. But the geology of large parts of Middle America is so little known that this negative argument carries small



MAGNIFIED CHIP OF THE TUXTLA STATUETTE

FIGURE 2 *Jadeite jade. Asiatic jades are of a different color*



NEPHRITE JADE—ANOTHER PHOTOMICROGRAPH

FIGURE 3 *The structure differs greatly from jadeite jade*

weight. On the other hand, several considerations lead us to the confident belief that jade does occur there and that it will eventually be discovered, most probably in both regions

One of these considerations is that many of the worked jade objects indicate clearly that the original material was found as water-worn boulders or pebbles. This is evident either from the shape, to which the artist and the lapidary adapted the design, or from the presence of portions of the original surface of the pebble

An interesting example in which both of these features are present is the so-called Tuxtla statuette, ploughed up in 1902 near Vera Cruz, in Mexico, and now one of the most prized possessions of the United States National Museum in Washington This little figure, about six inches high and three

LEFT SIDE OF THE TUXTLA STATUETTE
Figure 4 *The inscriptions were brought out with chalk*

and one half inches wide at the base, is composed of a pale, grayish green variety of jadeite jade The statuette represents a priest dressed in a ceremonial bird costume In carving this figure the Maya artist—one of great ability and with a feeling for realism rare in Maya art—has evidently been constrained to adapt his design to the shape of the boulder. Remains of the original water worn surfaces are clearly visible on the front of this statuette (Figure 1), on the left side (Figure 4), and on the back (Figure 6).

The statuette, by the way, is of special interest as being the oldest *dated* object of native American art that is known. It is impossible, as yet, to read the Maya hieroglyphs that run vertically down the sides and back, but students of American archaeology now know very well the characters used by the Maya to express numbers and dates, so that we can interpret the hieroglyphs that appear on the front of the image (Figure 1) These signify a date which, according to Dr S G Morley, corresponds to 96 B C, almost sixteen hundred years before the coming of Columbus.

A number of beautifully carved small figures, some of them of the most precious variety of bright green jade, have been made from flat pebbles, but were carved only on the front, leaving the original pebble surface at the back. Similarly, many of the beads, large and small, of which thousands have been found, show the irregular shape of the original pebble. Indeed, many examples are to be seen in the museums of this country and of Europe

It is inconceivable that any people, crossing the broad Pacific, would load their canoes with pebbles, even of the precious jade, especially if they had been driven away by stress of weather

Another fact that points to the indigenous origin of Middle American jade is that jade beads and other objects are named as among the annual tribute paid by conquered tribes to Montezuma and earlier Aztec kings This implies a constant and fairly large source of supply over many years, a supply that a few chance canoes could not possibly have furnished The enormous number of jade objects that have been found in Mexico and Central America points to the same conclusion

When one remembers that, doubtless, but a small percentage of the objects have been recovered, it is evident that had the jade come from Asia many fleets of large canoes, or a long continued system of transportation from Asia would have been necessary to supply the demand for jade in Middle America

"Not Proved"

The tribute roll of Montezuma furnishes another feature of much interest, and probably one of practical importance Many of the ancient towns and districts that were called on to furnish jade as tribute have been identified by Mrs Zelia Nuttall, who finds that they are mostly in southern Mexico Furthermore, it has been noted that, whereas strings of beads were demanded from most of the localities, large pieces" of jade were called for from those in a certain section As Dr G F Kunz says "Here is a well defined region, southeast of the City of Mexico, and not far from Vera Cruz, in which the mineral must certainly exist in place" It seems more than likely that, by following up these and other such clues, jade, both as pebbles and in place, will eventually be discovered in Mexico and also in Central America There can now be little doubt of its existence in Middle America

We come now to the second postulate of the argument, that the American material is identical with the Asiatic. Almost all the jade, called by the Aztecs *chalchihuitl*, that is found as worked objects in Mexico and Central America, is of the jadeite variety, very few nephrite objects having come to light during explorations

RIGHT SIDE OF THE SAME STATUETTE
Figure 5 *So far only the date has been deciphered*

I have recently studied many specimens of Middle American jade, with rather unexpected results Most of the specimens examined were beads and other objects that had been thrown as offerings into a sacred well at Chichen Itza, in Yucatan, the material being kindly put at my disposal by Prof Tozzer, of the Peabody Museum in Cambridge, Massachusetts others came from other localities in Mexico and Central America

The dominant colors of Middle American jade are green and gray The green varies from a vivid pistachio green to a very pale gray green the first was evidently the most valuable The grays vary from almost white to dark gray, and some specimens are mottled in white and light green The colors

THE HIEROGLYPHS ON THE BACK
Figure 6 *The oldest dated American object of art*

of the American jades, on the whole, differ decidedly from those of the Asiatic jadeite jades, the grays, especially, which are very common in America, not being found in Asia Also the American mottled green and white differs from the similarly mottled very precious *feitsui* of China Again, the pure white jade, so common in Asia, is not found among the American material The objects show a very high polish

Study with the *microscope and by chemical analysis* shows that most of the American jades are *mixtures of three minerals* jadeite, diopside, another pyroxene, a silicate of lime and magnesia, and a feldspar albite, a silicate of alumina and soda, as is jadeite, but with more silica and of different crystal form The two pyroxenes crystallize together, forming a homogeneous, new variety of pyroxene, but the feldspar crystallizes in separate crystals The mixtures of diopside jadeite and albite form a regular series, varying from pure pyroxene to almost pure feldspar The green color is due to the presence of chromium

Now although pure jadeite occurs in place in Asia and is the material of many of the American objects, among Asiatic jades the combination of jadeite and diopside is rare, and the mixtures of pyroxene and feldspar are almost unknown

The mineralogical and chemical evidence, therefore is against the view that the American jade was brought from Asia

The Fondest Dreams of the Astronomer

Things He Hopes For But Seldom Realizes. A New, Giant Telescope Is His Next Hope

By Henry Norris Russell, Ph.D.

Professor of Astronomy, Princeton University Research Associate of the Mt Wilson Observatory California

THE astronomer, like other people, has his dreams Admirable as are his best instruments, and his most favorable opportunities for studying the heavenly bodies, he always wants more—or at least wishes that still better means were available But the form which these wishes take is not always that which the layman in the science would suppose

Take, for example the student of the planets, who almost alone among astronomers, except for the observers of double stars, spends his time and energy in looking directly with his telescope at the objects of his study One would naturally suppose that what he most desired would be a greater magnifying power, so that he could get better views of the things he spends his life in studying Ultimately, this is doubtless true, but ask him about it, and he will tell you that, under ordinary observing conditions, he does not use the highest magnifying powers of which his telescope is capable—for he would gain nothing by trying to do so He must look through the miles of air above his head, and, since the atmosphere is never perfectly calm the images waver and dance, and too often are blurred, so that high magnifying power only magnifies the confusion He will tell you, then, that what he really desires is "good seeing"—continuous steadiness of the image, undisturbed by atmospheric tremors

Good seeing is a matter of climate—in a very special sense, and, before any modern observatory is located, the seeing is tested by taking a fair sized telescope to the site and observing on not one, but many nights A high altitude above the dense and smoky lower air, is an obvious advantage But the top of Mount Everest would probably be an extremely poor place for an observatory, even if it could be made easily accessible, for the currents rising along the precipitous slopes would stir up a turmoil in the atmosphere and would spoil the scene A high plateau, or a mountain top which does not rise above others in the chain is far better and in such locations the dreams of men such as Hale or Lowell have become realities

But it may be that the observer is concerned less with the study of fine detail than with keeping a continuous watch upon his chosen object In this case he still seeks good weather, but his personal definition of an ideal climate is one in which it is never cloudy In such work as the measurement of the sun's heat, where haze, as well as clouds, interferes with observation, the astronomer's dream is of a "lodge in some vast wilderness"—a high cloudless, rainless, and if possible a dustless region A perfectly bare rocky desert would be his ideal—barring such minor matters as living quarters

Fixed Stars Not Quite Fixed

Dr Abbot of the Smithsonian Institution, has just returned from a world wide search for such an ideal situation for making observations of the solar radiation Arid regions in many lands were visited More than one presented a fair approach to the desired minimum of cloudiness and moisture But complications intervened when the dream began to take shape *

Making the dream come true is always hard work, although it may not involve isolation in a trying climate Consider, for example, the specialist whose field has to do with the slow motions of the stars across the heavens—the *proper motions*, as they are technically called From these he hopes to find much more than is now known about the motions of the stars in space and of the sun as well But in work of this sort, he must deal not with individuals, but with averages Mere dozens or hundreds of stars will not suffice him He needs thousands, and he dreams of tens of thousands as the base of his future investigations

Thirty Years on One Problem

How shall he realize this dream? By the patient accumulation, one by one, of observations of these almost innumerable stars—getting several observations of each star, so as to have a good average—determining all the imaginable errors of adjustment of which his instrument is capable, and allowing for them—and then finding out new and previously unsuspected sources of minute error, and getting rid of these When all this is done, he compares his work with all the observations of previous investigators—for it is only in this way that the motions of the stars can be found—and finds sometimes that he has to delve into the original records left by his predecessors, and work out the results anew The enormous labor of such investigations can hardly be appreciated except by those who have done similar work—yet many astronomers have devoted their whole careers to this apparently dreary task and in some instances the work has been handed on from one generation to another

But it is not only the observer who dreams dreams and sets out to make them real We have seen one of quite a different sort come true when Brown's "Tables of the Moon" containing the results of nearly thirty years of mathematical investigation of the highest order, came from the press This particular problem—that of calculating the moon's motion under the gravitational attraction of all known bodies—now appears to be definitely solved but there are plenty of unsolved problems left for others to dream of

Consider, for example, the asteroids of which more than a thousand are now known To calculate the orbit of one of these miniature planets—as that of the moon has been computed—so that its position in the past and the future may be worked out as accurately as there is hope of observing it, is often more difficult from the mathematical standpoint than in the case of the lunar theory Complete tables which should give the motions of all the thousand and more little planets, with this degree of accuracy, are beyond the very dreams of our present age in science—if indeed so colossal a task might not rather be called a nightmare

But to construct approximate tables, which enable the motions and positions of these planets to be predicted for a few decades in advance, accurately enough to make sure of keeping track of them, although still a very heavy piece of work, is nevertheless possible

The astrophysicist whose studies relate to the *physical properties* of the stars and whose instruments are the spectroscope, the photometer, and the thermopile, discusses one thing above all others—more light If he is fortunate enough to be a student of the sun, he has light enough, to be sure, and so in this case his dreams are likely to be of perfect seeing This is hard to get by day when the sun's rays heat the air—and thus this worker dreams of a telescope and spectroscope free from disturbances by the wind or by changes of temperature. These dreams again have taken form in the tower telescope

But in the greater field which is found among the stars—not to speak of the nebulae—there is never light enough to leave a bit to spare In spectroscopic work, for example, the star's light, when spread out into a spectrum, is practically always too faint to be studied with profit by visual observation. Photography, with its cumulative action, is unconditionally necessary

Still more is this the case with the nebulae The outer portions of the great nebula in Andromeda, for example, are so faint that the eye can never hope to behold them They cover so large an area of the sky that, if they were bright enough they could be easily seen with the unaided eye Now, an optical instrument—field glass or telescope—may make an extended object look *larger*, but it cannot make it appear brighter per unit of apparent area, nor increase the amount of light which falls upon a square millimeter of the retina of the eye If an extended object is too faint, intrinsically, to be seen directly, it can never be *seen* at all Here the photographic plate, with its patient continuance in summing up the action of the light makes possible what must once have seemed beyond the reach of dreams, and reveals objects that no one can ever hope to see

The fondest dream of many astronomers, therefore, is naturally of more rapid plates, which will cut his exposure times in half—or if the dream is bold—diminish them far more When one reads of exposures of six, ten, or even of eighty hours (continued from night to night, whenever the weather and other conditions permit) one may guess what a boon to the astronomer the discovery of a method of producing such faster plates would be

What hope there is of the realization of this dream is still uncertain A few years ago it was supposed that the theoretical maximum of photographic action had been nearly reached—that a single silver-grain on the plate was made developable by a single "quantum" of light energy But recent work has proved that this is not the case, and there seems to be a wide margin for possible advance The problem is very intricate, for the system of tiny crystals of silver bromide suspended in a colloidal layer of gelatine is one of extreme complexity from the standpoint of physical chemistry But this leaves all the more chance open for possible progress in the future

Chemistry Comes to Astronomy's Aid

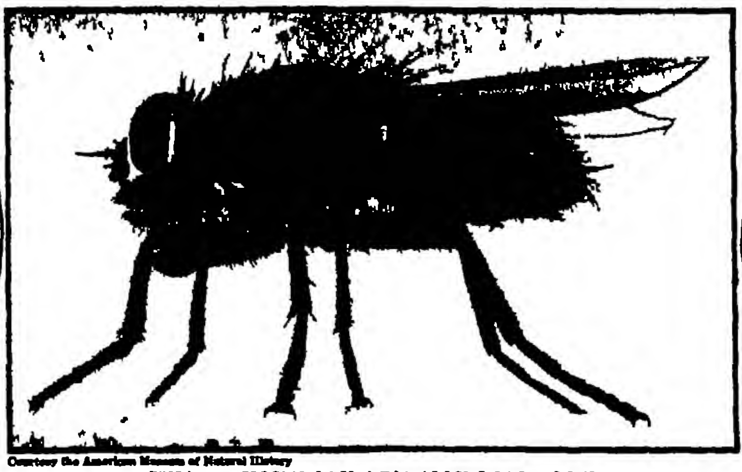
In this case the commercial value of success would be very high, so that there is likelihood that funds for research will be available Work is known to be going on at the Bureau of Standards, in the laboratories of the Kodak Company, and doubtless in other places. [In this as in other instances the mention of the work of American investigators must not be taken to mean that important and valuable work is not being done in other countries.] What the outcome will be only time can tell.

But do not astronomers dream, besides these things, and perhaps most of all, of greater and more powerful telescopes? Indeed they do; but this story would take longer in the telling, and we may hope to hear from it again, and soon.

* An account of Dr Abbot's search is presented in the Scientific American Digest on page 132

THE FEET THAT KILL

When flies wade knee deep through filth these little spines gather disea e germs



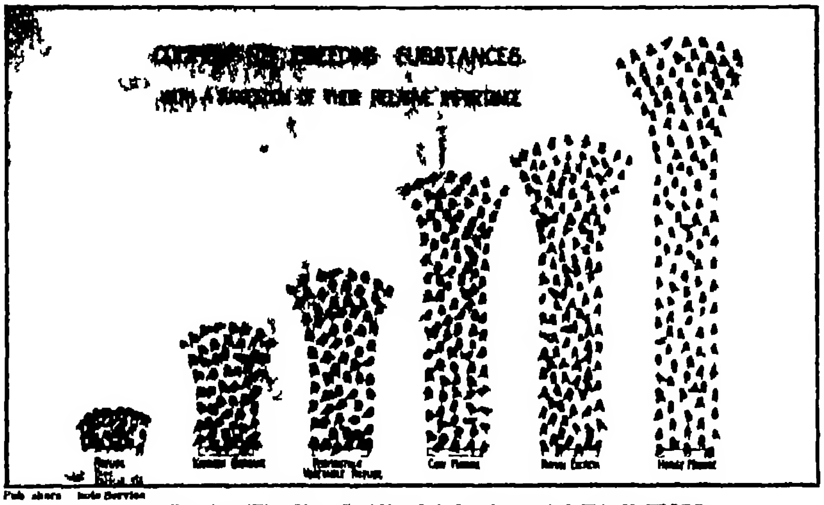
Courtesy the American Museum of Natural History

WHAT A HOUSE FLY ACTUALLY LOOKS LIKE

His bo ly is cover l with a compl te assortment of pines f vari us degrees of sharpne s Germs lurk among th se a l are droppe l i to our fo l

LIKE A SODA WATER STRAW

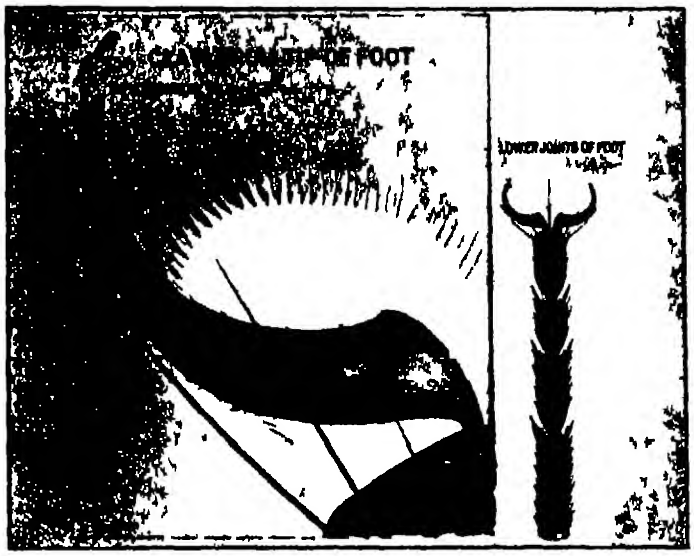
Tl fly s prol sc s is a suck g apparatus It a t i ject g ms t to us



Pub shers Photo Service

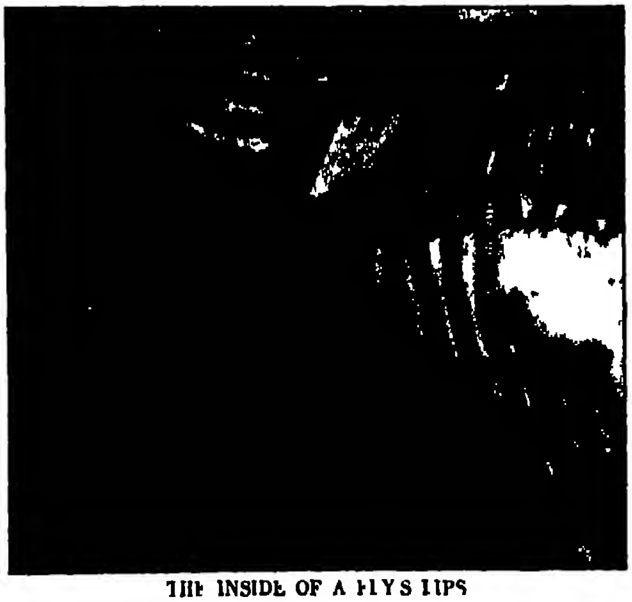
DO AWAY WITH THESE AND YOU DO AWAY WITH FLIES

Swatting flies helps but why let them breed at all? Without the breeding places named above flies are quite out of luck Manure is th wor t off nder



A FLY'S FEET ARE USUALLY DIRTY

When it walks n th l lys fie t tracks g n s aft r it exactly as a loy tracks mud over t cl a i fl r Of tl t fho l l i llac are o b o c k d



THE INSIDE OF A FLY'S LIPS

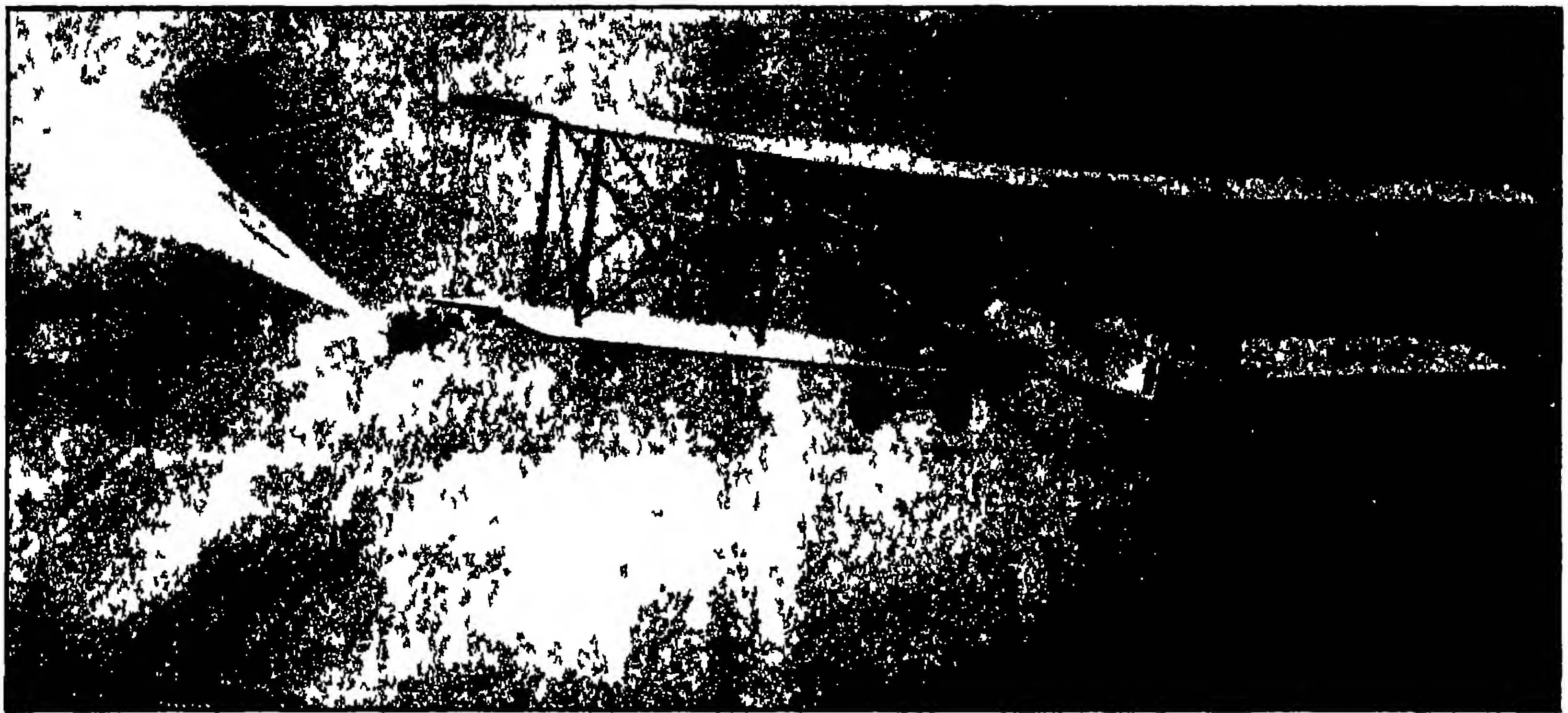
An unusual picture The diagonal division is between the lips The tubes shown are not the tongue as stated in another magazine

FLIES ARE MINIATURE PORCUPINES

H re is a patch of a fly i ng mag f d 300 dia t r The dim, shadowy hairs ar tl e i l r st l of this th n membrane

If House Flies Were as Big as Birds

Have you ever taken a few minutes off in order to observe closely the behavior of a common, live house fly with regard to food? If flies were as large as birds, so that we could see their parts more clearly, we would all think more seriously about their noisome habits Yet the fact that they are small is not significant, for they can nevertheless carry millions of disease germs on their hairy feet and bodies Do not underestimate the house fly because he is little It is not, however, by a fly's mouth that germs are spread The mouth examined under a microscope, is a surprise It lies between two half oval surfaces at the lower end of its proboscis The latter can easily be seen without a microscope bobbing up and down touching the food Contrary t wide pread belief there is no apparatus on th common house fly for penetrating the skin even of a baby The proboscis is merely a sucking device Stable flies however have a sharp tongue with which they suck blood exchanging for it their own saliva



All ph tographs by A A ton

THE P LLOFF STANDING ON THE AIRPLANE WING THE JUMPER IS PULLED OFF BY THE PARACHUTE

The Education of a Parachute Jumper

Technique Is Important if One Is to Alight Safely After a Leap from a Speeding Plane

By Milton Wright

ANYONF may drop ftom an airplane no particular skill is necessary Further more anyone who diops may reason ably expect to arrive in due course of tin e at the ground A question which then presents itself is will you remain lying on the ground oblivi us of your surrounding or will you lie all in one piece rise ar l walk off as if n thing had happened

THE OBSERVER'S PARACHUTE

Tl s t pe lo o h nd nove t t the cock p t

That depends upon tw thiugs first did you come down hanging to a para hute and second how did you conduct y urself with regard to this parachute? There is a right way and a wrong way to do every thing and para hute jun ping is no exce tion to the rule

In the latter part of the World War the British R yal Fly g Force began to study the question of issuing to its flyers a parachute which should be an avenue of escape in times of necessity Occasionally an aviator w uld be killed or in jured after a collision with other air raft when fire had broken out in the air ard it had been imp ssible tc extinguish it or when the plane had become uncontr llal le owing to some defect in the structure or the controlling mechanism

Free-type Parachute Now Standard

It was found that m d rr para hutes fall into two lass —th static ty e which depends for its operati n u on i line atta hed t the aircraft and the free tv e which is erated either automatically or by the ju er himself after he leaves the plane The stat type was f lly rejected after trial be ause the li e was likely to f ul s me part of the ir raft and thus fail to pen the parachute By no n s ll this type l considered 100 percent effi ei t

Ir the pr g of 192 the British Air Ministry le de l i ad pt as th standard equi ment of the Roy l A r F r e a free type parachute known as the Ir i g arachute Th s had been devel pe l by the U t l Stat s Arm y nd Navy Aviation C rps and l l pr ved to le alt gether efficient Steps were t k i a rdingly t equip all Royal Air Force air raft w h this free type pa a hute

When a hipmert f parachut s arrives in England from the tr tors in America they are sent to the parachi te testir g station at Henlow, Bedford There the parachutes containers and harness are examined to see if they conf rm to the specifications If they do they are submitted to a tual tests for while a parachute might l ok all right the question of how it will act in the air is after all the important thing

Several of the parachutes are taken up in an air plane at one time for drop testing A 200 pound weight is attached to the harness of each parachute and in the case of every fiftieth parachute a delay

THE PILOT'S PARACHUTE

Sitting on it his arms are free for working the controls

THE RIP-CORD RING
When the jumper pulls this ring, the pack opens and a pilot parachute is released, which pulls out the large one

REAR TRAINING PARACHUTE
For practice, two parachutes are provided one on front and one on back If one should fail, the other is used

COMPLETE TRAINING EQUIPMENT
The main parachute is in the pack over the stomach while the reserve one is carried strapped to the back

action is set for 500 feet, so that the release may operate under far more severe conditions than would obtain when it is in actual use If the parachute fulfills all the required conditions, it is accepted, repacked in its container and sent to the particular flying unit which is being equipped

In the ordinary course of flying, all pilots ascend equipped with a pilot's type parachute, and observers, air gunners and wireless operators, with an observer's type. The difference between the two is that the pilot sits on his parachute, while the observer, gunner or wireless operator wears his adjusted to his chest. The reason for this is that in the case of the pilot it is necessary to have the parachute out of the way when he is operating the airplane and engine controls. In the case of the other men, who have to move about in the aircraft, the parachute gets in his way to a less extent if it is in front of him rather than behind him

When flyers go up in the air to practice jumping, however, two parachutes attached to the same harness are used The reason for this is that the jumper may have a reserve parachute in case his first one fails. So far, however, it is said that there has not been a single instance when it has been necessary to use the reserve parachute

To operate the parachute is a simple matter The rip cord is pulled and a flap of the container, operated by means of elastic cords, opens These cords are in tension and a small pilot parachute is ejected This in turn pulls out the main parachute The shock of the main parachute taking the strain of a jumper's weight is not absorbed by elastic cords, for with this type of parachute, shock absorbers have not been found necessary.

Stepping Into Space

This shock of opening, in fact, has been described as "a very pleasant jerk" And why not? Picture yourself starting to fall through the air The little jerk, even a severe jerk, that means your parachute had opened, is a pleasant thrill you would be reluctant indeed to miss.

When it comes to practicing live drops, volunteers only are used, the Royal Air Force being unwilling to make a man jump if he does not wish to Hitherto the demand for practice live drops by officers and men has far exceeded the facilities for giving them

Practice is given by two methods The "pull-off" and the "jump-off." It is advisable that the "pull-off," being less trying to the novice than the "jump off," be practiced first

In the "pull off" the jumper stands on a small platform on the lower wing of a large airplane and holds on to one of the struts. When the pilot is at the right height and position to bring the jumper down to good ground the pilot gives a signal The jumper pulls the rip cord of his large parachute At once it opens and drags him away. If by some mischance the cord fails to open the parachute, the parachutist remains safely standing on the wing of the plane

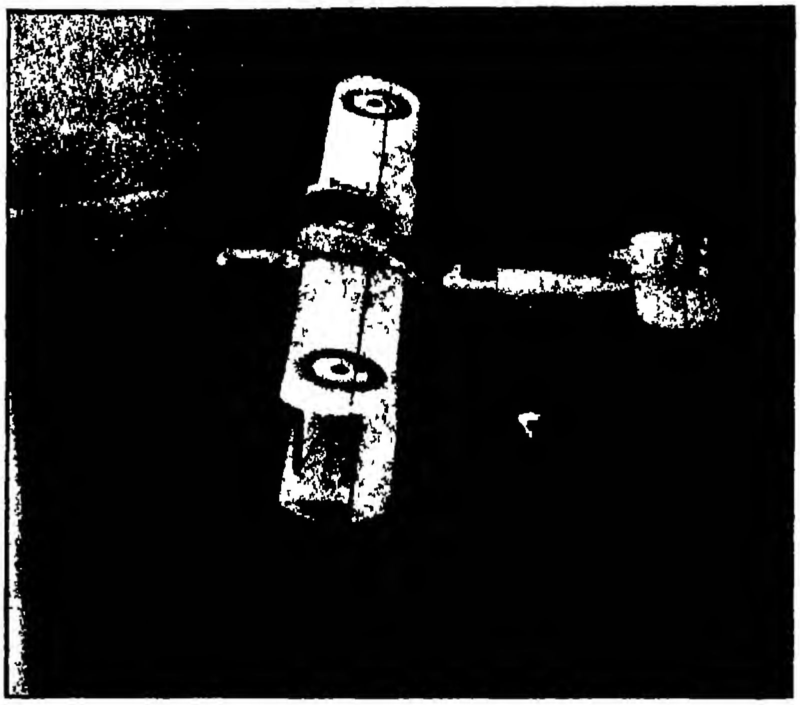
Slow motion pictures have been taken of the "pull-off" method In every one of these the determination of the jumper to hold on to the strut as long as possible against the inexorable pull of the parachute may be plainly seen To hang on as long as possible seems to be the instinct of every parachute jumper

When the "jump off" method is to be followed, the pilot throttles down the engine and gives a preparatory signal. The jumper climbs over the side of the airplane and descends a short ladder, holding one hand on the rip cord He gives a nod to the pilot, who opens up his engine to increase the speed of the airplane, and steps off backward into space

The jumper has been told to pause until he has dropped at least ten feet below the machine before pulling the rip cord Some authorities have recom-

THE PARACHUTE PACKING ROOM
The sergeant is holding up the small pilot parachute while the main one is folded up The pack is spread out on the table Note complete pack at the right

TRAINING PARACHUTE PACKERS
In order to insure perfect operation of the parachute, great care is necessary in the packing The parachutes are laid out on long tables and then carefully folded



AFTER PULLING THE RING

This photograph, taken from the air, shows the pilot parachute just emerging from the pack in response to the jumper's pulling of the ring attached to the rip-cord

SUPREME CONFIDENCE

This is what the jumper must have in his parachute if he is to drop from a speeding air plane and trust to the proper opening of his aerial life-saver

mended that the novice jumper be told to count three before pulling the cord, but such instructions are useless, the Royal Air Force has found. An excited man may count three in the tiniest fraction of a second, and the state of mind of a novice jumper is such that he might pull the cord so soon that his parachute would foul the tail of the plane.

Just as the jumper begins to imagine his parachute has failed and he is about to look for the rip cord of the reserve parachute, he feels "the very pleasant jerk" he had almost ceased to hope for, and realizes that the reserve parachute is unnecessary. Then for a time he begins to swing like a pendulum. Soon, however, this swing damps down, if it does not do so naturally, the jumper can manipulate the cords between the parachute and the harness to assist the natural damping.

Now it is time to think about making a landing, and the jumper must so manipulate the cords of the parachute that he faces down wind. By so doing he will fall forward on his hands and knees when he strikes the ground rather than backward or sideways, or on his back or the side of his head and thus he will avoid injury.

A tree, a pond, a hedge or some other undesirable site is likely to be the spot the jumper is headed for. In this case, he may side slip clear of the obstacle by pulling down the cords on one side of the parachute.

When the feet appear to be three or four feet above the ground the jumper pulls himself up as if he were on a horizontal bar. This greatly reduces the shock. Otherwise, the impact for a 154-pound man would be equivalent to a jump off a ten-foot wall.

Few Make This a Hobby

The jumper has one more thing to do, and that is to spill the air out of the parachute by pulling the cords on the upper side. If he fails to do this he is likely to be dragged a little after he strikes the ground.

Practice jumping, as far as possible, should take place under favorable weather conditions. It should not be done if the wind is blowing a velocity greater than 15 miles an hour. In ordinary flying, however, should a jump be necessary, the rate of the wind is of small account, for it is far better for the flyer to go down with his parachute and suffer a broken leg than to remain with his machine and suffer a broken neck.

The average person is entirely satisfied with one "pull-off" descent and one "jump-off." He has gained the necessary confidence in the use of the parachute and knows that in an emergency he will have little reluctance in throwing himself out of his plane.

Small tendency, however, has been observed among average mortals to take up parachute jumping as a hobby. While it is true that the few officers directly responsible for parachute training have demonstrated drops a great number of times, they probably did it more because it is their job than because of the thrill they get out of it.

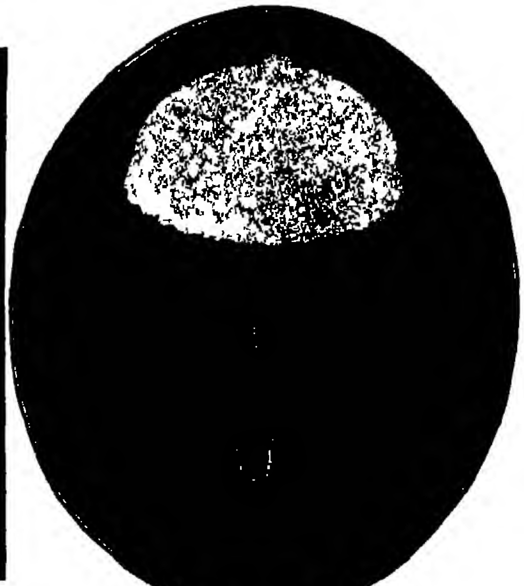
That there is a thrill, however, there is no denying but there are safer thrills to be found.

BOTH PARACHUTES OPEN

It is seldom necessary to resort to the use of the reserve parachute but it has been done as a demonstration

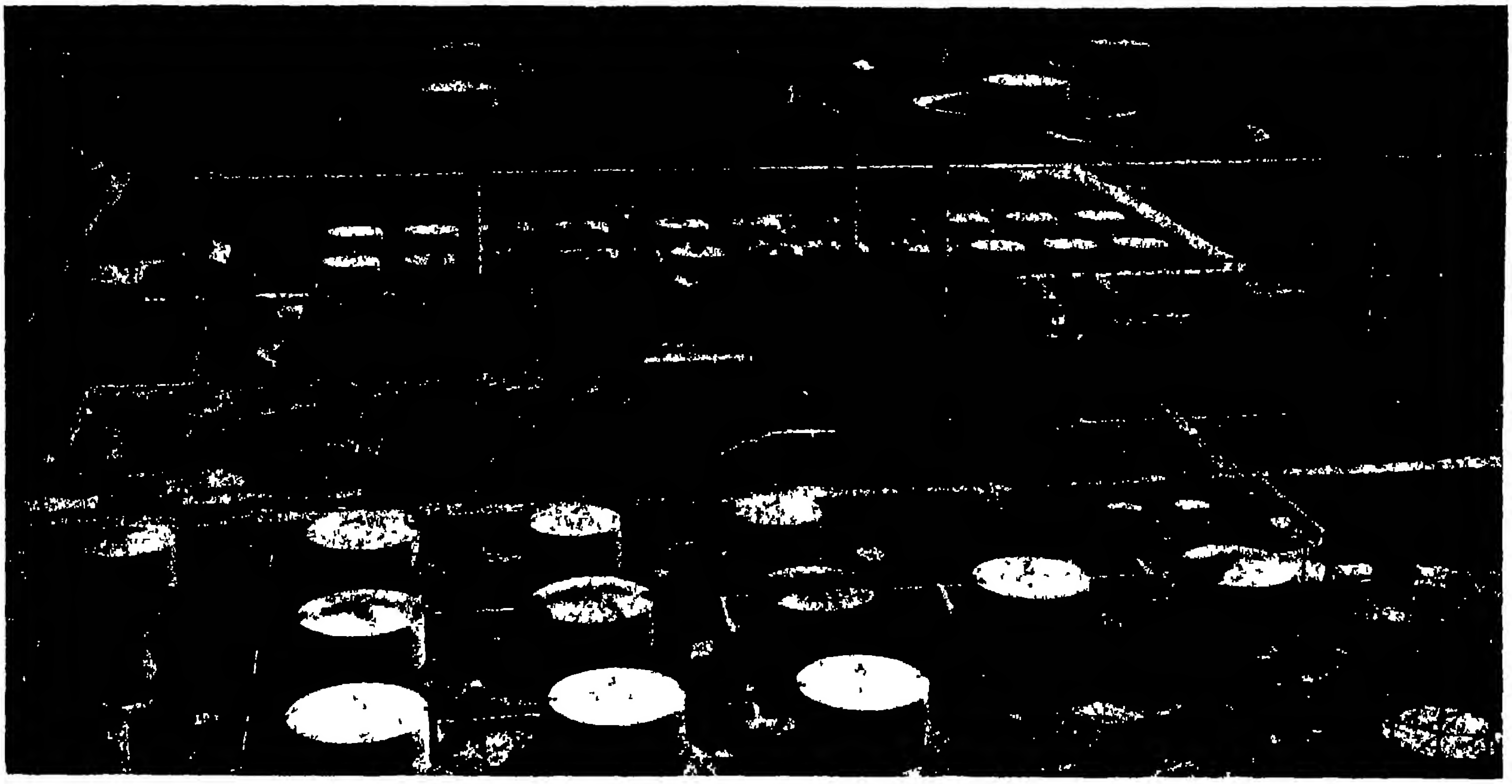
STEERING THE PARACHUTE

Pulling on the suspending ropes enables the operator to guide the parachute to effect a safe landing



A PERFECT DESCENT

Note the small pilot parachute spread on top of the main one where it fell after performing its important duty


An Oil Refinery at Houston, Texas, Where the Distillation of Crude Oil Is Carried On

Uncle Sam, Spendthrift—III

Present "Grab-all-you-can" Policy in Oil Drilling Is Criminally Wasteful. Regulated Cooperative Drilling Is Necessary to Prevent a Future Oil Famine

By J Bernard Walker

WHEN President Coolidge appointed the Federal Oil Conservation Board, he wrote a letter which showed what a thorough grasp he had obtained of the fundamental facts which govern the demand and supply of oil The letter opens by stating "it is evident that the present methods of capturing oil deposits is wasteful to an alarming degree, in that it becomes impossible to conserve oil in the ground under our present leasing and royalty practices, if a neighboring owner or lessee desires to gain possession of his deposits" In another paragraph, he says that he is advised that our current oil supply is kept up only by drilling many thousands of new wells each year, and that "the failure to bring in producing wells for a period of two years would slow down the wheels of industry and bring about a serious industrial depression."

Elsewhere, he refers to the fact that the production of over 300,000 wells throughout the country is in excess of our immediate requirements, and that this over-production brings down the price of oil, and this in turn leads to a wasteful and extravagant use of the oil

It is evident from the tone of the President's letter—which, by the way, represents the attitude of many of the most experienced, thoughtful and far seeing of our oil specialists—that he is anxious about the future of the oil industry and realizes that, although the oil resources of the United States are of vast extent, the demand for oil is growing so rapidly and the methods of recovery of the oil are so wasteful, that the country may find itself rather suddenly confronted with disaster in the shape of a positive oil famine with far-reaching effects

Prior to the gathering of the Oil Conservation Board, the American Petroleum Institute investigated conditions in the oil industry and published a report, replete with statistics that are, of course, thoroughly reliable so far as existing facts are concerned Our criticism of this work relates only to that part of it in which the Committee passes from facts to opinions. When the report enters the field of prediction, it seems to us that it is altogether too optimistic, and tends to lull the country and the government into an attitude of unjustifiable security as regards our future oil supply

Are Oil Supplies Inexhaustible?

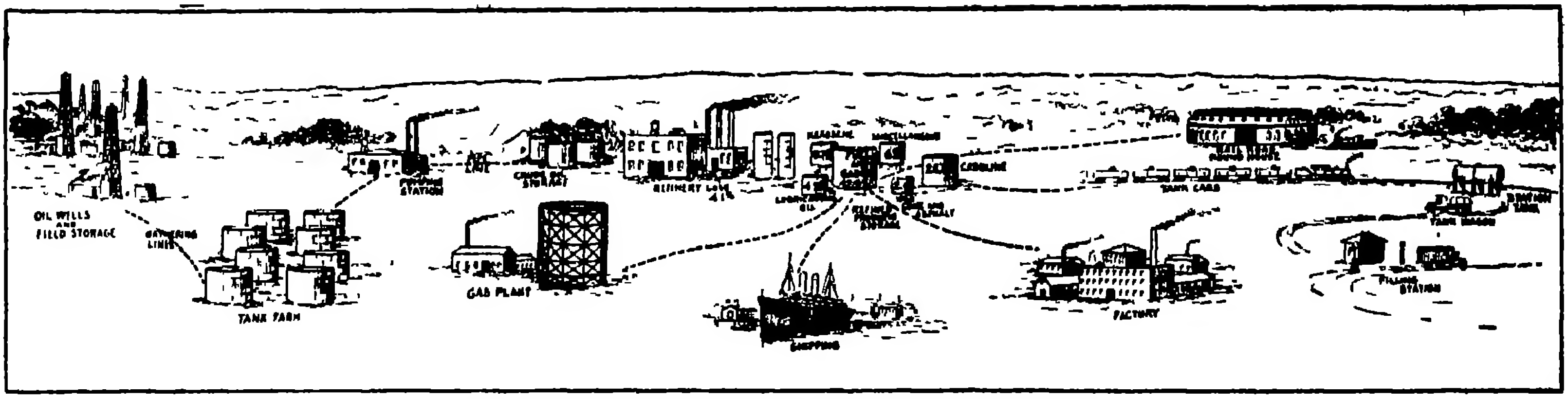
A study of the report shows that it arrives at three major conclusions First, that our reserves of oil are practically inexhaustible, second, that though our production may fluctuate, there will be no danger of an oil famine, and, third, that there is a negligible amount of wasting of oil in the industry

In the matter of supply, the report deals, first, with those oil reserves whose amount cannot be estimated, and, second, with those whose amount can be subjected to estimate As regards those reserves whose oil content cannot be estimated, we read that "the greatest of the national petroleum reserves consist of 1,100,000,000 acres of as yet unexplored and unproven land inlaid with sedimentary rocks that await the drill" Under the heading "Reserves Susceptible to Computation," the report lists the present producing wells which it believes to be capable of producing, by flooding and pumping methods, 3,210,449,000 barrels of oil; and from proven but undeveloped lands it estimates a recovery of 2,110,178,000 barrels The Institute, therefore, believes we may be certain of a future recovery of 5,321,000,000 barrels of oil from the present producing wells, and from lands which we know to contain oil but which have not yet been opened up

In the chapter on oil in the June issue, we drew attention to the fact that only a limited percentage of the oil in the sands is recoverable by flowing and pumping, and that for every barrel of oil recovered, three barrels of oil are left in the sands. Further investigation shows that we were too conservative It is nearer the truth to say that for one barrel recovered, four remain in the ground Basing its calculations, evidently, upon the 80 percent of oil remaining in the sands, the Institute Committee estimates that, after natural flowing and pumping have brought up all they can, there will remain in the area which is producing and proved, 26,000,000,000 barrels of crude oil, "a considerable portion of which can be recovered by improved and known processes such as flooding with water, the introduction of air and gas pressure, and mining," and that these methods will be resorted to when the selling price of crude oil justifies the expense of recovery

Then the report states that, when the price justifies, it will be possible to treat the vast supplies of oil shale, in which it is estimated there is a reserve of 108,000,000,000 barrels

Should the time ever come when even the oil shales are exhausted, it will be possible to obtain from our huge coal deposits a total of 525,000,000,000 barrels of liquid products yielding 92,000,000,000 barrels of motor fuel, to say nothing of 70,000,000,000 barrels from lignite Thus, the In-



THE DISTRIBUTION OF CRUDE OIL AND ITS VARIOUS PRODUCTS

The oil, as it comes from the wells is first stored and then pumped to the refinery where it is distilled The resulting oils, et cetera, are then distributed to the consumers

stitute report arrives at a grand total of future supplies of petroleum of over 734,000,000,000 barrels.

A very respectable total, were it based upon well established facts But it is not so based, for, in spite of the high character and undoubted ability of the men who have written the report, this estimate of future recoverable oil supplies, is, after all is said and done, largely a guess

The underlying trouble with the petroleum industry is that the law of supply and demand, which governs all other industries, is inoperative in this But we must not imagine that any monopoly exists Far from it The trouble dates back to 1875, "when a Supreme Court Justice of the State of Pennsylvania, initiated that line of analogy, out of which was eventually phrased the dictum 'oil and gas belong to him who reduces them to possession'" Had the judge followed the prevailing law regarding minerals that they were "property in place," the present disastrous methods of oil recovery might have been avoided But since the oil as it exists in the ground is fluid, it would have been necessary to provide some method of fair distribution of the oil as it was brought to the surface, the distribution being based mainly upon the respective acreage of the various owners of the surface properties So true is this, that today it is becoming increasingly evident to the oil industry that, for the stabilization of the industry, for the placing of oil recovery upon a practical, scientific basis, for an equitable distribution of the oil based upon surface ownership, for the elimination of the present enormous waste, both of oil and capital, and, above all, for the maintenance at all times of a generous reserve of oil, it is necessary that what has come to be known as "unit operation" be established in the industry.

In other words, cut-throat, grab-all-you-can competition must give way to mutually cooperative drilling.

Under the present methods, as we showed in the previous chapter, the work of oil recovery is being done on the principle of "first come, first served" As soon as a new well is brought in, there is an immediate rush to buy up the adjacent surface lands and drive down wells with all possible speed to tap the fruitful sands More often than not, the free gas is allowed to go to waste, for it is the oil that the drillers are after No effort is made to preserve the gas pressure, and consequently, only a fraction of the oil is recovered, leaving in the ground a vast amount that could have been brought to the surface if the wells had been properly spaced, as they would have been under a cooperative, unit system, and if care had been taken to maintain the gas pressure at the highest possible limit.

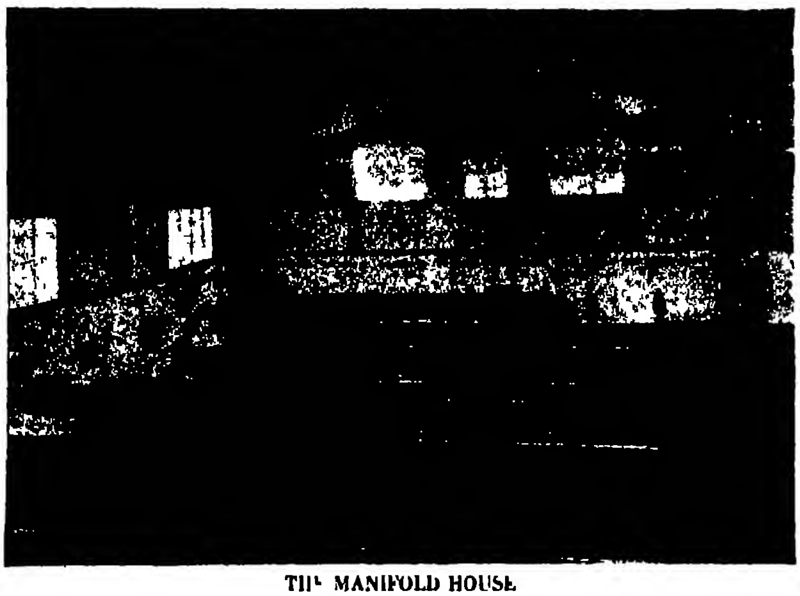
Eighty Percent Left in the Ground

Gas is the most important agent in the recovery of oil From the first rush of the giant geyser to the last barrel that is brought up by pumping, it is gas pressure and gas pressure alone that is the great expelling agent

Let us look at this all important question more closely The oil, as we have seen, is distributed in the microscopically small interstices of the rock sands. It is under enormous pressure and the pressure is maintained because of the strata of gas tight rock which lie above and below the sands A proportion, in some cases a large proportion, of the gas is free, but the greater part is condensed in the oil Under present methods, little or no care is taken to conserve the gas, and therefore the pressure, in the sands. As the gas escapes, the ability of the remaining gas to expel the oil falls rapidly. Furthermore, the gas condensed in the oil renders it less viscous—more fluid. Oil may be so rich in gas as to be as fluid as gasoline In this condition, it can be forced freely out of the sands; but as the gas escapes, the oil thickens and flows with increasing reluctance It clings to the surface of the voids, and capillary restraining effects become more active Hence it is that, under the present wild methods of operation, after the first great rush and escape of gas and oil, the yield dies away so rapidly that, when the last barrel of oil that it pays to lift has been pumped, 80 percent of the oil remains gummed up, as it were, in the sands

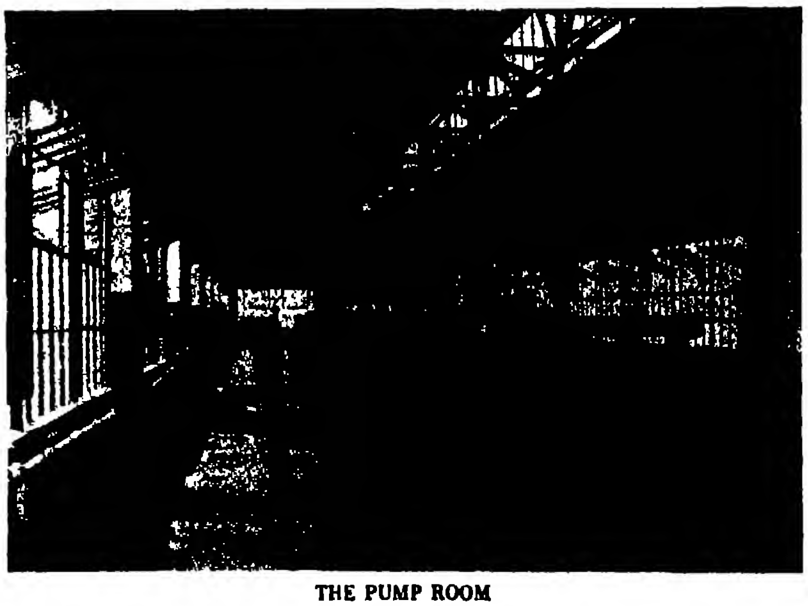
Cooperative unit operation, with wells so scientifically spaced as to secure a gradual withdrawal of the oil to meet the current demands of the industry, would prevent the present wild fluctuations in the supply (and the price) and the wells, so operated, would constitute a vast reserve of known or closely known quantity

But even with unit operation, it is doubtful whether the recovery by drilling and pumping could be much more than doubled It is probable that 50 percent of the oil would still remain below ground Hence, a great deal of thought has been given to the problem of recovering the oil by some more effective method, and the latest, and in our opinion the most promising plan, is that known as the Ranney Process, so named after the well-known engineer who developed it Realizing that gas pressure is the great expelling agent, Mr. Ranney's system seeks to maintain this pressure unimpaired until all or practically all of the oil has been expelled.



THE MANIFOLD HOUSE

From this point, the distribution of the crude oil through trunk lines is controlled



THE PUMP ROOM

The oil in the refinery is in constant motion, passing through this room several times

His method is made very clear in the accompanying illustration.

Briefly stated, Mr Ranney's method is this a shaft is driven down through the oil sandstone into the shale or other impervious rock below it From the bottom of the shaft, a series of tunnels is driven through the underlying gas tight shale Holes are drilled at short intervals through the roof into the sandstone, and they are connected with an oil pipe line within the tunnel The gas pressure is main tained by means of compressed air pipes which lead into the upper portion of the sandstone As the lower parts of the sand are drained, the oil settles down from above under the influence of gravity and air pressure The oil pipe line leads to a separator, which has a gas out let pipe at the top and a water tap at the bottom The oil is led from the sep arator to a vacuum pump, by which it is lifted to the surface

The main shaft of the system is driven in the center of a 40 acre tract, which is the unit of oper ation The tunnels with their mine wells are placed around the edge of each unit, and since these little oil drainage wells are spaced about ten feet apart, it follows that there are 528 wells through which the oil from 40 acres may be recovered

Most Promising Fields Already Exploited

In view of the naval, military and industrial in terests involved, it is positively appalling to realize that the oil industry is literally "living from hand to mouth" We have been using up our oil as though the supply were a mighty and ever flowing river instead of a cistern of great but absolutely limited capacity Nobody on earth knows how much that cistern holds All we do know is that, under the present methods anyone is at liberty to bore into the cistern insert his own spiggot and draw off just as much as he can get We do know that the great army of well drillers carries a banner whose motto reads 'Every man for himself and the devil take the hindmost' We do know that under this wild free for all scramble, the rate at which the cistern is being emptied is increasing at an ever accelerating pace

Julian D Sears of the United States Geological Survey, reminds us that it required forty one years and four months to produce the first billion barrels

CHOKING OFF A GUSHER
These pipes and valves prevent escape of oil and gas

of oil, that it took only eight years and one month to bring in another billion barrels and that only one year and seven months were required for the seventh billion to be brought to the surface In the presence of this rate of increase anyone who tells the American people that the cistern has prac tically no bottom, is doing the country great dis service and is heading the oil industry for disaster

In looking to the future let us keep our eyes upon well ascertained facts There are five states—Penn sylvania West Virginia Ohio Indiana and Illinois whose oil bearing areas gave as rich promise for the future as does the area we have left Neverthe less although the rate of consumption was then but a fraction of the consumption today these prolific fields were drained out in a comparatively few years No one can offer a sound reason for believing that we shall get a greater proportionate yield from the oil bearing territory which is left

In closing this chapter mention should be made of the encouraging fact that nearly all of the large companies have come to realize that it is absolutely necessary to check indiscriminate and wasteful drill ing Recent developments in California prove this Furthermore, we must remember that the areas which are known to be oil bearing have been sub jected for years to a thoroughly scientific search by an army of trained oil geologists upon whose findings and advice the wells of the great oil com panies have been drilled Hence, it is reasonable to believe that under such exploration, the most prom ising fields have already been exploited and the richest pools drained away

The fact that the supply of oil has hitherto kept pace with the rapidly increasing demand, is due to the accidental finding of some enormously rich pools, such as those in California and the midwest Over 300 000 wells are producing about 2 000 000 barrels a day but about 25 percent of these wells are dry holes and it is said on good authority that in the banner year—1923—over $91 000 000 was spent in drilling dry wells throughout the United States In 1921 James McIntyre writing in the *Oil and Gas Journal* showed that in Kansas, Okla homa Texas Arkansas and Louisiana 4 779 test wells were drilled on untested leases and of these 2 382 failed to bring up any oil In these tests 111 coun ties gave 100 percent failure represented by 225 wells, and in 29 other counties, 614 dry wells were driven representing 73 7 percent failure In 1921 Marland writing in the *National Petroleum News* stated that the American petroleum industry since its beginning has sold its oil for $4 900 000 000 less than it cost to drive the wells and lift the oil

Where Is the Industry Heading?

The continuity of the oil industry is dependent upon the accident of bringing in a flood of oil from wells of enormous production In August 1923 says Mr Sears half of the production of the United States or 1 000 000 barrels a day was com ing from only 3 500 wells in eight oil fields The other million barrels were coming from 275 000 wells scattered throughout the rest of the country"

Less than two percent of the wells were yielding 50 percent of the oil

If that two percent had not fortuitously been brought in at the psychological moment," where would our industry have been?

In our September issue we shall show how oil may be conserved by better drilling and refining and how by using high speed motors 40 percent increase in automobile mileage may be secured

LOADING THE TANK CARS
In the background are the pressure stills and storage tanks In the foreground is the load ing rack Note the jointed pipes used for filling the tank cars

THE RANNEY MINING PROCESS
The compressed air forces the oil from the sandstone whereupon it flows through pipes and is pumped to the surface Notice the oil and water separator

Artist's Conception of the United States Airplane Carrier Saratoga in Action

Giant Floating Aircraft Bases

"Saratoga" and "Lexington" Are Unique in the History of Naval Construction

By J. Bernard Walker

NEARING completion at the yards of the New York Shipbuilding Corporation, Camden, New Jersey, and of the Fall River Shipbuilding Corporation at Quincy, Massachusetts, are two great warships to which that much abused term "unique" can be applied without fear of contradiction. Aircraft carriers have been built before—lots of them—but never has there been put afloat a carrier of the combined size and speed of either of these remarkable ships.

To understand just why they are what they are, it will be helpful to give a brief resume of their history dating from the year 1916 when, under their original design, they were classed as battle cruisers of 35,300 tons. As such, they formed two of a squadron of six, which was part of the famous 1916 naval program. Subsequently, and because of certain lessons learned from the British navy, these ships were provided with an exterior bulge as a precaution against torpedo attack, and other changes were made which raised their displacement to 43,500 tons.

When the first designs were made public they were subjected to severe criticism (in which the Scientific American took a rather prominent part) because of the fact that of the 24 boilers, 12 were located above the protective deck and therefore above the waterline, where they were liable to be wrecked by the first "straddle" of an enemy's salvo. The Navy Department realized the force of this military objection and in the subsequent redesigning of the ships, in which the bulge and other new features above referred to were incorporated, they took the opportunity to redesign the boiler plant, substituting 16 boilers of larger capacity in place of the previous 24 and placing all of these boilers in their proper position below the protective deck and therefore below the waterline. These battle cruisers greatly exceeded all existing or proposed ships of similar types in size, speed and gun power. The main particulars were as follows: Length on deck, 875 feet; extreme breadth, 106 feet; mean draft, 31 feet; normal displacement, 43,500 tons; and speed, 33.25 knots. They carried a powerful armament of eight sixteen-inch, 50-caliber guns in four turrets, and an anti-torpedo armament of sixteen 6-inch, 53-caliber guns, in addition to four 3-inch anti-aircraft guns.

An 800-Foot "Landing Field"

Under the Washington treaty for the limitation of naval armament, the United States and Japan were allowed to select two capital ships, which were then under construction, for conversion to aircraft carriers. The battle cruisers *Lexington* and the *Saratoga* were selected by the United States Navy. These carriers were not to exceed 35,000 tons displacement. Accordingly, the plans were again redrawn to convert these two ships which were already partially constructed, into aircraft carriers. Our wash drawing shows the *Saratoga* as she will appear when in service, and the accompanying photographs, taken while she was yet under construction, give an excellent impression of the characteristics of these truly remarkable sister ships. As redesigned, they measure 850 feet long on the waterline and 880 feet on deck. The extreme beam is 106 feet and the draft will be something under 30 feet.

Of the revised battle cruiser design, it may be said that all which remains is the hull and the motive power—everything else has been completely changed to meet the requirements of aircraft service. Viewed from any angle, whether abeam, ahead or astern, the ship is not now recognizable as the trim, rakish looking battle cruiser with its two elliptical smokestacks, its two lattice masts, its four big sixteen-inch gun turrets and its powerful secondary battery amidships. In the first place, the whole of the original superstructure has been swept away. Gone are the 16-inch guns, the massive turrets, the heavy cranes, and other battle cruiser accessories. Instead of the low, rakish craft as originally planned, we have a huge hull with a flying deck which everywhere, throughout the full length of the ship, towers 60 feet above the water, or nearly twice the height of the original design whose loftiest deck had little over half as much freeboard. The two smokestacks have been replaced by a huge, elongated structure enclosing the uptakes, which is about 70 feet in length and extends about the same distance above the flying deck. To provide a clear deck for the airplanes when landing or flying off, this smoke stack, together with the turrets, military mast, et cetera, has been moved over to the extreme starboard side of the ship with the result that the airmen have a "landing field" which has a clear width of between 85 and 90 feet throughout the greatest part of its length and extends unbroken by any obstruction for 880 feet. The lines of the fore deck have been swelled out in order to give greater width at the bow, the extreme end of which has been cut squarely off. This effect is seen clearly in our bow view of the ship. Towards the stern the deck is carried out beyond the hull, and in order to prevent a low flying or disabled airplane from hitting the

after edge of the deck, it is carried down for the last 20 feet of its length at an angle

Ranging along the deck amidships, immediately below the flying deck, are a series of recesses within which are nested the ships' boats. Above the boats, at each end of each recess, is a horizontal davit arm, electrically operated—these arms swinging out when a boat is to be launched or recovered. The officers are berthed aft below the flying deck, and at the extreme after end will be noticed the stairway and landing by which the personnel can pass from one deck to the other.

Although these ships have lost their great 16 inch guns and their numerous battery of 6 inch guns, they are still formidable fighting craft for their main battery consists of eight 50 caliber, 8 inch guns carried in four armored turrets. Both guns and turrets, it is needless to say, are of the latest pattern, the guns being of high velocity and great range and power. The turrets, like the smokestack, are carried close to the starboard side of the ship.

Will Carry 72 Planes

These huge ships, each carrying 72 planes, will, of course, be subject to fierce attack—the very first object of attack if possible—by the enemy. Their speed will protect them against surface ships, but when the attack comes from the air, they will have to depend upon their own airplanes and upon their anti aircraft battery. This battery is one of the finest features in the ships, for it is not only numerous but it consists of the latest type of long caliber high velocity 5 inch guns, with a vertical range far exceeding the height at which any attacking planes will fly. Six of these guns are mounted forward, three on each beam, six are mounted aft, and all of them are so placed as to command an absolutely vertical limit of angular fire. The forward guns are mounted on sponsons which extend sufficiently far out from the hull to enable the guns to fire vertically without interference by the flying deck. The after guns are carried on the main deck where the flying deck is cut away as explained earlier in the article. This anti aircraft battery is furnished with the latest instruments for determining the height and the distance of an approaching airplane and the mechanism is such that the elevation of the guns is automatically adjusted to keep continually trained on the airplane during its approach. Their rate of fire is very rapid and they will be able to direct such a storm of shell, that the enemy will be forced up to an altitude at which the chances of dropping a bomb upon the ship will be very remote.

All photographs courtesy General Electric Company

A BOW VIEW OF THE *SARATOGA*

Note the wide deck cut off square to increase space

The importance of this defense can scarcely be over estimated, for it can readily be understood that the detonation of one or two bombs on the flying deck would probably wreck it so completely as to render it an impossible surface for the flying on or the flying off of planes. This, to our thinking, is the most vulnerable feature in all airplane carriers and doubtless in an attack there will be many a heroic pilot who will be willing to take a chance by diving down through the barrage in the hope of getting close enough to make sure of a hit.

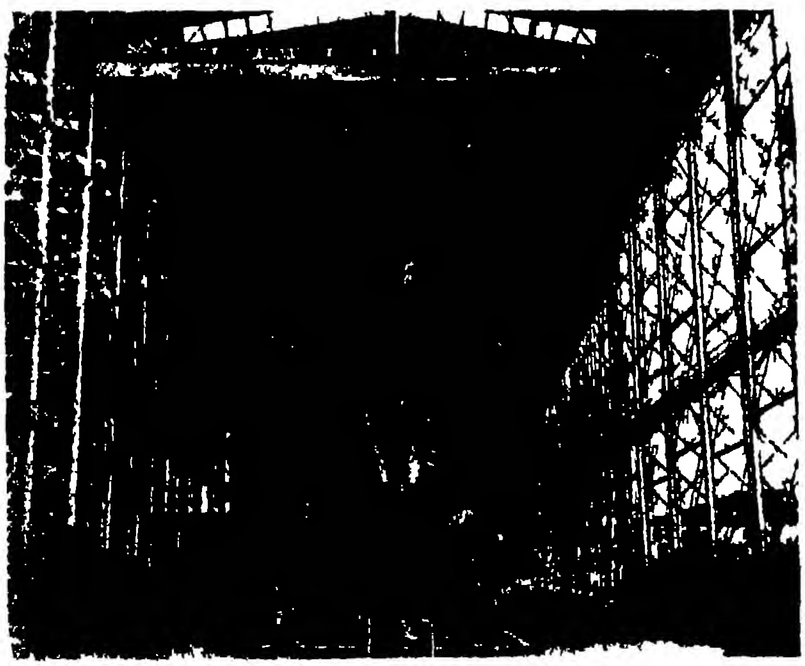
Between the smokestack and the forward pair of turrets are the bridge and the fighting mast. In these ships the lattice mast has been abandoned and the well known British tripod mast substituted. At the top of this type is located a gun control house of a type generally similar to those with which the public is familiar on our battleships. On the after side of the smokestack is located a secondary gun control house which is smaller but similar in its equipment to the main control position on the mast. The navigating bridge, it should be explained, runs entirely around the tripod mast at about its mid height. Above the tripod will extend the customary topmast with its yards for signaling purposes.

Before closing this description something should be said about another remarkable feature in these ships, and that is the motive power, which is of the turbo electric type that has been so fully tested out with satisfactory results as to maneuvering power in our latest battleships. In brief it consists of steam turbines direct connected to electric generators. The current is led through a controlling station to eight large electric motors which are mounted in tandem on the inboard ends of the four propeller shafts. When it is stated that the total designed shaft horsepower of the *Saratoga* is 180,000, it will be realized that all of the various units in this power plant are of exceptional size, exceeding anything of the kind previously mounted on a ship. The electric plant would be sufficient to supply the light and power requirements of the city of Boston.

A Complete Aircraft Base

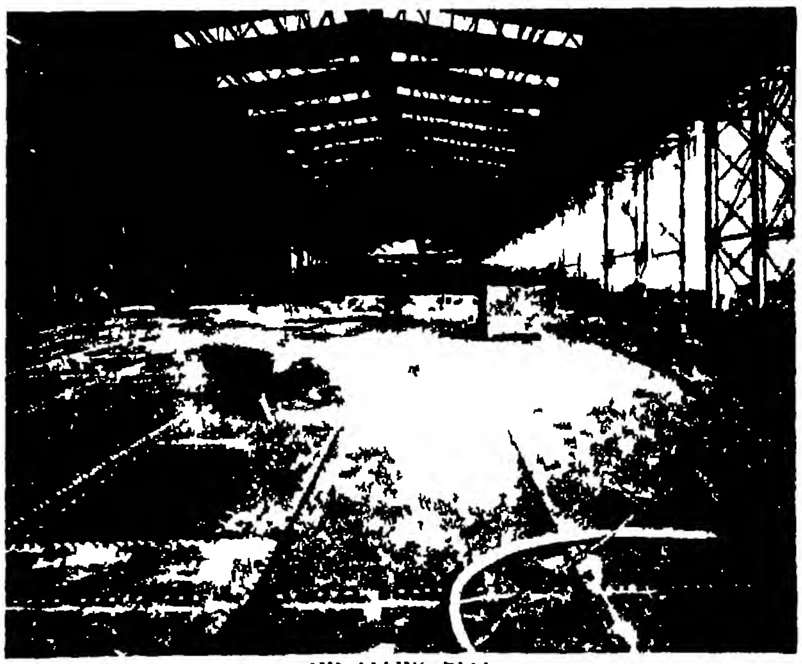
Throughout all the many changes which have been made in these ships, the power plant has remained pretty much as it was originally designed and since the ships are several thousand tons lighter due to the removal of heavy guns, turrets and armor it is reasonable to expect that on their trials they will develop a speed of 34 knots. If so, this will put them, as far as speed is concerned, in the class with our fastest destroyers—in still water. In disturbed water when the seas run high they will easily draw away from attacking destroyers.

It may have been noticed that in this description we have said nothing about the interior arrangements of the *Saratoga*. This is in accordance with the wishes of our Navy Department which, like those of all other naval powers, is keeping the internal arrangements of the aircraft carriers a carefully guarded secret. Judging from our present aircraft carrier the *Langley*, it is safe to say that the interior will provide for the storage of airplanes, space for their assembly, and elevators to bring them up in the assembled condition to the flying deck. There will also be the necessary machine shops and repair facilities, large tanks for the storage both of the ship's oil fuel and of the large quantities of gasoline for the supply of the airplanes. Over and above this, room must be found for berthing the crew.



THE *SARATOGA* FROM ASTERN

The great height and the rugged construction of the ship are readily seen



THE FLYING DECK

This photograph, taken in the construction shed, shows the clear sweep of the deck

The Physics of Golf Balls

Science Could Show the Sporting Goods Manufacturers How to Make Better, Faster and More Elastic Golf Balls, Tennis Balls and Baseballs—A Challenge

By H. H. Sheldon, Ph.D.

Chairman of the Department of Physics, Washington Square College, New York University

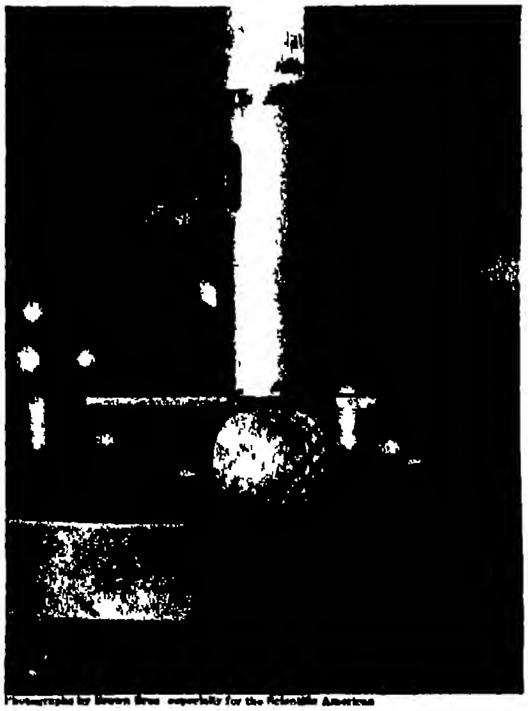
OF recent years, a great deal has been written about golf. The stance, the relative values of steel and wooden shafts, and other fine points have been discussed very fully. But the part of the game that deserves the most careful study is the ball itself.

After all, any kind of hard, heavy object will do to hit the ball with, while the man with an incorrect stance does not necessarily make the shortest drive. Given a poor ball, however, the results are sure to be poor.

Measuring the Bounce

Provided the ball is kept within the prescribed limits of size and weight, there are left but two variable factors to study, its elasticity and its surface markings. Of these, the elasticity is the simpler to test because, regardless of all sorts of fancy tests that may be devised, the only one that gives real information as to how far the ball will go when struck with a given blow is the "bounce" test. If one drops a golf ball from a given height, how far will it return? This test does not, however, measure "elasticity" in its scientific sense. Instead, it measures the "coefficient of restitution," and this is the important consideration.

It is possible to measure the elasticity of a ball by placing weights on it and noting its decrease in diameter (compression) per unit of weight added. This test flattens the ball a bit at the bottom where it touches the table and at the top where it touches the weight. It also bulges it out at the center (Figure 1.) Obviously, the strain produced is not due to compression, shear, or stretch. Nevertheless, it is some combination of these. Therefore, elasticity of some sort may be measured in this manner. Through such experiments using weights up to 40 kilograms, the author has found, however, that there is no connection between this effect and the height of rebound after falling. That is, a poor ball may require either a greater or a lesser force to compress it a given amount than will a good ball. A poor ball is also likely to acquire a permanent "set" more quickly by this test than will a good ball, but this is not necessarily so.



Photographs by Brown Bros. especially for the Scientific American

STATIC VERSUS DYNAMIC MEASUREMENTS

FIGURE 1. *Measurements under static conditions apparently have no connection with action under dynamic conditions*

Another Alibi

Now that vacation time has arrived, Professor Sheldon has turned his attention to the lowly golf ball. He places the blame for short drives and for slice and pull, largely on this diminutive sphere. This means that it is the manufacturer of the ball who is to blame for the shortcomings of this product, for the ball itself could doubtless be improved by scientific experimentation.

In the accompanying article Professor Sheldon explains how to measure the "coefficient of restitution" of the ball. On this coefficient depends the length of your drive on the links.

Here is a new excuse for the poor golfer. The coefficients of the ball are wrong!

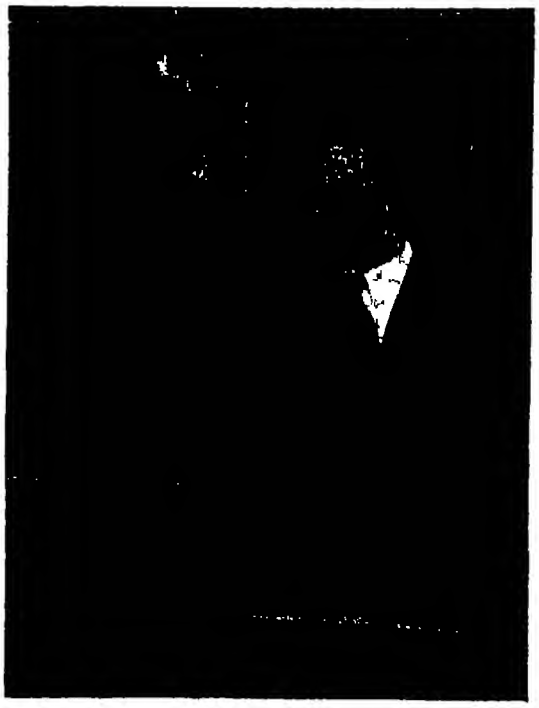
To those who are already familiar with "hardness" testing, it will be seen that the kind of test mentioned above is not very different from such a "hardness" test as, for example, the Brinell test. In this, the force required to push a steel ball a given distance into a surface is measured. This suggests, incidentally, that other kinds of hardness tests might be used for testing golf balls. Tests that were made with the scleroscope were found, however, to be of no value. In testing hardness with this instrument, a small steel "bobbin" is allowed to fall on the object and then rebound. This rebound gives a measure of the hardness. Obviously, this ought to give the same result as allowing the ball to fall on steel and itself rebound, and this result would be obtained if the ball were of homogeneous material throughout. As this is not, however, the case with a golf ball, since the bobbin is small (weight about 40 grains) only the surface material or covering of the ball is effective. The same method with a large weight would, of course, be effective, but it is obviously easier to test the ball by dropping it. Other testing devices such as the durometer and elastometer also measure properties of the surface layer only.

This rebounding property of the ball is of such fundamental importance that the coefficient of restitution should be given by the manufacturer. Fewer claims should be made without giving the information obtained by the rebound test to back them up. Without going into the mathematical analysis, the coefficient of restitution, thus obtained, is found to be equal to the square root of the height from which the ball is dropped, divided by the height to which it rebounds. Stated as an equation, $e = \sqrt{h_1/h_2}$. In order to find this value accurately, the ball should be held in some sort of a release: for example, between two strip-brass springs or in a clamp, as shown in Figure 2, and allowed to drop on a hard, rigid object such as a block of iron. (Materials such as wood will dent slightly and spoil the result.) As the eye is easily deceived if the ball is not viewed strictly on the horizontal at the top of the rebound, it is necessary to use a ring and to look across its top so that both sides are seen at the same level. Its height should be adjusted until the top of the ball just shows above on the rebound. Both of the heights must, however, be taken from the bottom of the ball.

Why a Smooth Surface is Undesirable

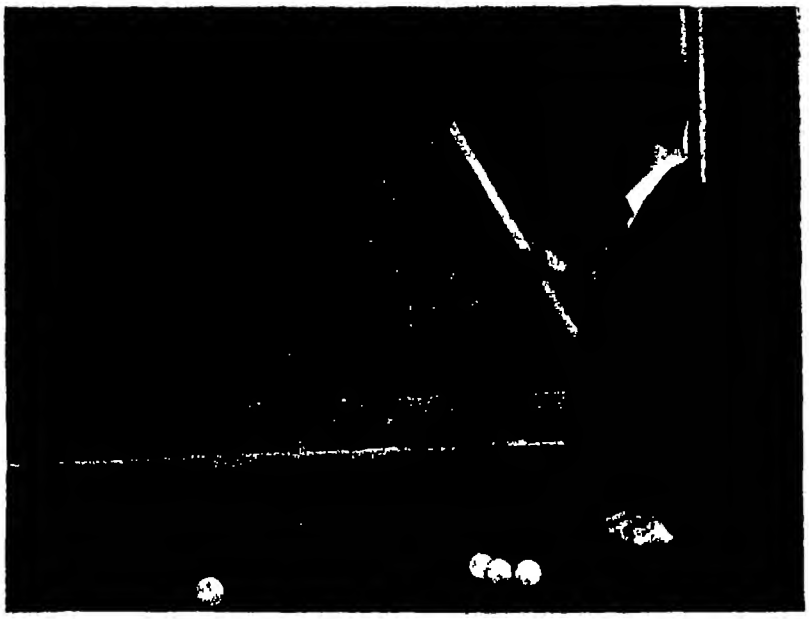
Balls measured in this manner showed a variation in the coefficient of restitution ranging from .76 to .87. It was also noticed that the poor balls fell off with increased height, which was certainly not true up to considerable heights with good balls. Of course, heights corresponding to the normal distance of flight of driven golf balls were not employed in these tests, and it would therefore be interesting to make tests at places where facilities in the form of a high tower, building, or cliff might be available. In order to be of real value, a study of this sort should be made and correlated if possible with the various constants of the pure materials (measured by such instruments as those mentioned above) which go to make up the ball. In this way, a better ball than any yet constructed might be evolved, much to the delight of the experienced and serious golfer.

With regard to the markings on the surface of the ball, much information of interest and value may be obtained. When a ball spins, due to a slice or pull imparted in the driving stroke, the friction with the air brings about a difference in pressure



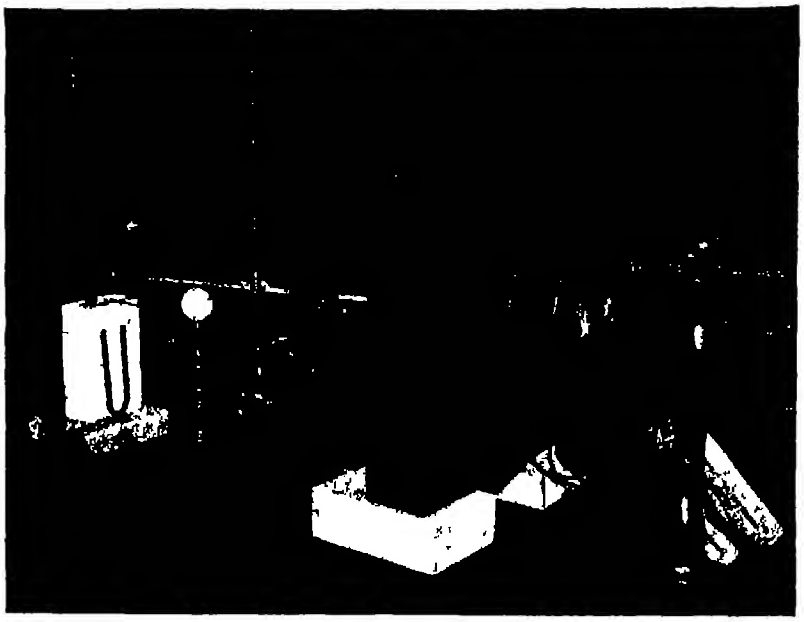
THE COEFFICIENT OF RESTITUTION

FIGURE 2. *This measurement under dynamic conditions requires no more equipment than is shown, together with the equation*



EFFECT OF SPIN ON FLIGHT

FIGURE 3, (a and b) *The solid arrows in the figures show the direction of spin and translation of the ball when in flight. The dotted arrows indicate the kind of putt that will result*



MEASURING PRESSURE DIFFERENCE

FIGURE 4. *When the ball is rotating, the liquid in the manometer is higher on one side than on the other. The "egg crate" prevents the air from whirling and affecting the results*

on its two sides (with regard to the direction of flight) and this causes it to follow a curved path either to the right or to the left, depending upon the direction of its rotation. Looking down on top of the ball during its flight (Figure 3a) the effect of this spin is shown. Obviously, the greater the friction of the surface with the air, the greater will be the deviation from the true path for a given spin.

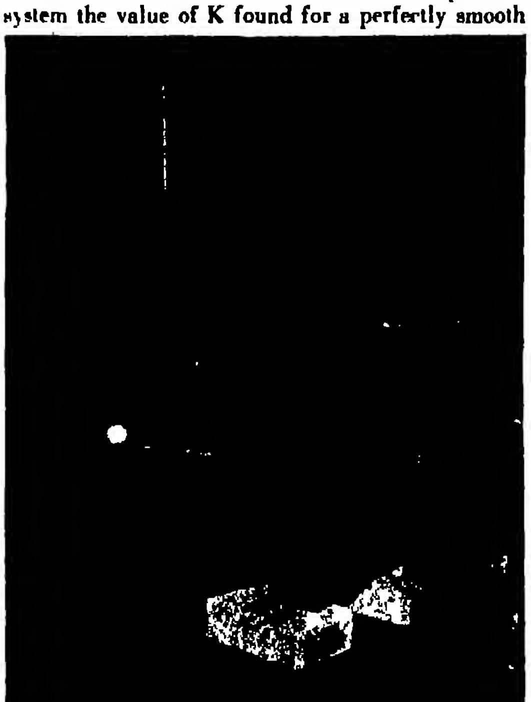
It may be asked, "Why not use a smooth surface and thus largely avoid this spin which results in deviation?" The answer is that one form of spin, an underspin produced by hitting the ball slightly below its center, is highly desirable, for this prolongs its flight. Figure 3b illustrates this spin when the ball is viewed from one side when in flight. It is necessary to strike only a very little below the center in order to give a considerable underspin. On an average drive about one twentieth of an inch is enough. In addition to this useful underspin, in making difficult shots it is sometimes desirable purposely to use some slice or pull, thus obtaining the curved flight due largely to the effect of markings on the ball. At the same time, the friction with the air caused by a roughened surface must not be so great as to impede the progress of the ball too greatly.

Analyzing the Spin

The proper surface markings should obviously be those that will give the maximum effect due to spin, with a minimum of air resistance. At first it might seem that these two things would be the same, for the spin effect is, itself, due to air friction. It should be observed, however, that the velocity of any mark on the ball due to rotation may be quite different from its velocity due to translation through space. Coupled with this is the fact that the air resistance is roughly proportional to the square of the velocity of the ball. This results in spreading farther apart these two effects above mentioned. Further, a large portion of the air resistance is probably due to the impact of the air against the nose of the ball, whereas the other effect is due entirely to friction at the sides.

Sir J. J. Thomson has measured the difference in pressure on the two sides of a spinning golf ball. He rotated such a ball rapidly on a spindle, directing at it a blast of air, and found the pressure difference by means of a water manometer (Figure 4). He showed that the pressure difference on the two sides $(P_A - P_B) = KV_b V_s$, where K is a constant, V_b is the velocity of air, and V_s is the velocity of spin. This constant K, will obviously depend on the markings of the ball and it might well be specified for each type of ball sold. The amateur who is likely to slice badly could then give up any advantages of underspin which he is incapable of controlling and purchase a ball having a low constant K.

It is by no means a simple matter to measure K without proper tools. It would require a device such as a tachometer to measure the velocity of spin, and a pitot tube to measure the air velocity past the ball. Comparative values are easy however, to obtain. This may be done by using the same driving motor revolving always at the same speed in connection with an air blast blown from a fan through something of the nature of an egg-crate. The latter precaution is taken in order to avoid air spin. The exhaust end of a vacuum cleaner might also be used, or any other type of blower that is handy. As only comparative values are necessary, tests of this sort answer very well and we might therefore use as the unit values of our comparative system the value of K found for a perfectly smooth ball. This would at once eliminate all troublesome velocity measures.



EFFECT OF AIR FRICTION

FIGURE 5: *The greater the air friction, the farther back the ball will be driven by the action of the air blast*

It has been shown by P. G. Tait that the resistance of motion of golf balls through the air ("head on resistance") is proportional to the square of the velocity. It seems extremely unlikely that this resistance would be affected to any great extent by the markings on the ball although some small effect might possibly be observed. This relation between head on resistance and velocity could be shown by supporting the ball by a long thread attached at either side and projecting a blast of air in such a direction as to cause it to swing back to a steady position, as shown in Figure 5. In such a case, the frictional force due to the air blast can be shown to be approximately $F = Wx/l$, where W is the weight of the ball, x is the horizontal displacement from the equilibrium position in quiet air and l is the shortest distance of the center of ball to the axis of support. For large deflexions (more than 5 degrees) this simple equation does not hold. So we must write $F = Wx/l \cos \theta$, where θ is the angle between the vertical and the direction of the line from the ball to the axis of support. For those who do not understand trigonometry, let me say that $\cos \theta$ in the figure is equal to h/l.

Might Measure a Pugilist's "Wallop"

These experiments, then, supply the desirable facts about golf balls. It is obvious, moreover, that similar methods can as easily be applied to tennis balls, baseballs, billiard balls, and so on. If sportsmen would interest themselves in the determination of such constants, it is obvious that the manufacture of such articles would soon be revolutionized. Standardization would be brought about to such an extent that home-run records and so on would increase from year to year.

I have suggested very briefly a few of the possible methods of experimentation. Others and perhaps better ones will suggest themselves to other minds. Perhaps, also, other subjects will occur. For example, did Jim Jeffries have a harder "wallop" in his day than Dempsey, and if so, how much harder? Methods for measuring such things are easily available but they have not been used.

In our September issue, Professor Sheldon will present another article on simple practical physics experiments. His scientific explanations of everyday subjects in an understandable manner are always interesting to the layman

THE SPEED BOAT ON ITS LANDING CRADLE

The design of the hull is such that the boat draws very little water particularly at high speed. Note the combination of aerial and water rudder that makes steering easy

Air-driven Sea Sled Has Shallow Draft

New Water Craft Will Travel 30 Miles Per Hour in Only Four Inches of Water

A "GLIDER" or "sea sled" which is an interesting adaptation of elements taken alike from aeronautics and aquatics has been developed in the form of the so called "free bottom" craft which we illustrate. To prove that the designation free bottom is exact one has but to study the side view which shows an entire absence of propeller rudder water inlet scoop and other appendages usual to water craft.

This novel boat is powered with a 90 horsepower Curtiss motor and is steered by a combination of an air and water rudder which is supported in the blast of the eight foot airplane propeller.

IN SHALLOW WATER

Although the water is only knee deep note the man at the left this water sled travels along at high speed without trouble. It is admirably adapted to shallow river travel

No claims are made of remarkable speed for her size and power although she is capable of 35 miles per hour. Comfortable speed in a useful boat, which can travel in a minimum draft of water without sacrificing the advantages to be found in her class were the predominant ideas in her design.

Twenty six feet over all with a beam of seven feet four inches the draft when loaded and at rest is nine inches. Under full speed she actually lifts in the water till the draft is from three to four inches. Weeds and mud are not troublesome in fact in a pinch she can slide along on slippery mud. When placed on the handling truck the blast of the airplane propeller will send her out of the water and up to the boathouse.

For slow navigation the water rudder is necessary. This is so hinged that it will rise and freely pass over any obstruction over which the keel passes. As the speed of the air propeller increases, it acts on the small vanes seen on the sides of the air rudder forcing them back by a system of levers until the water rudder is clear. Like an airplane, the craft then steers entirely by the air rudder. On turns even at maximum speed, she heels in and runs free with her cockpit dry even in a choppy seaway. At idling speeds she will turn in a circle twice her length.

The engine is fully muffled and is mounted in airplane style giving free cargo space below. The propeller is protected by a steel guard and heavy screen which allows her to lay up to a dock or other boats safely. The sail like air rudder has a steadying effect in connection with the water rudder when running up to a landing preventing the bow from falling off with the wind.

The hull is of mahogany throughout highly polished on the decks and sides and painted with navy bronze on the bottom. The frames, stem and keel are of selected white oak. Both bottom and side planking are sealed with oak battens screwed in place.

Two passengers are accommodated in the driver's seat and three on the wider seat directly behind. The steering gear instrument board windshield, electric self starting device et cetera are all of the automobile type. The instruments include a Delco ignition and lighting system tachometer and water temperature indicator. The dials of the last two are carried under a glass panel.

A 40 gallon gasoline tank is located amidships. It supplies fuel for approximately five hours running at 30 miles per hour.

AT HIGH SPEED

The water rudder has automatically been drawn up and the boat is being steered by the air rudder in the same way as an airplane. The steering resistance is thus lowered

The Great Earth-Moon Catastrophe

By Albert G. Ingalls

WILL the much-debated Wegener hypothesis survive or must it be discarded?

This intriguing new theory of an Austrian geologist explains the earth's past geologic history more simply than any other Difficulties that geologists have got around only by elaborate interpretations, and some which cannot otherwise be explained, vanish in the light of the hypothesis that the continents are not stationary but are slowly drifting Yet, according to many scientists, there are fatal objections to it.

The Wegener hypothesis of continental drift was summarized by the writer last January, in the Scientific American It is completely explained in Wegener's book, "The Origin of Continents and Oceans." Briefly, Wegener believes that the several existing continents are the scattered parts of a former super-continent Fifty odd millions of years ago some stupendous world event broke this greater continent into several parts These pieces of rock—the present continents—floating in the denser, heavier rock below, gradually drifted apart Some of them are supposed to be moving yet North America, for example, is believed to be slowly drifting westward.

An Event that Convulsed the Earth

Wegener says the whole hypothesis of continental drift occurred to him, when he was studying a map of the world This was in 1910 He was impressed with the congruity of both sides of the Atlantic coasts It would be worth while, before reading further, to get a map of the world, or better still, a globe, and study it in this light Pickering's map, reproduced in the central illustration on this page, provides similar food for thought The two Americas have a peculiarly curved coastline, yet, curiously enough, that of Europe and Africa fits it like a jig-saw puzzle Wegener thought this was more than a coincidence He still believes the two land areas were once one

When Professor Wegener first propounded his hypothesis, it was frequently characterized as "simply another attractive theory" This characterization may turn out to be correct Today, however, and especially within the past year or two, the world's geologists, geophysicists and other scientists are treating it more seriously, although few of them accept it yet. This is a good beginning Discussion, argument, controversy—these beget familiarity Familiarity often leads to acceptance P. T Barnum, who understood the philosophy of getting publicity before the first publicity agent took his first job, said, "I don't care what they say about me as long as they keep on talking about me" As evidenced by the special journals of the scientific societies, the Wegener hypothesis has now reached the stage where scientists are talking about it

The most essential part of any theory that may be advanced to account for an event should be a statement of the *cause* of that event, yet Wegener is vague or silent concerning the original cause of the supposed break-up of the one time super continent He simply assumes that it took place It has remained for an astronomer, Professor William H Pickering, Director of the Observatory at Mandeville, Jamaica, B W I, and Professor Emeritus of Astronomy at Harvard University, to supply a theory of the break up Singularly, Pickering supplied this theory three years *before* Wegener conceived his own hypothesis

During or before 1907, Pickering had been struck, as Wegener was afterwards, by the "jig saw puzzle" congruity of the margins of the continents bordering the Atlantic Ocean He drew a map to illustrate it and published that map, with an article presenting his theory of the break-up of the original land mass of the earth, in the *Journal of Geology* The cause of the break up, Pickering believed (and still believes, according to replies to inquiries directed to him) was the birth of the moon from the earth, some 1200 million years ago In its astronomical aspects, this theory of the origin of the moon is accepted by most astronomers

"Assuming a hot, solid, ellipsoidal earth," says Pickering, "with an interior more or less liquid, at least beneath the equator, revolving on its axis once in about four or five hours, we have a picture of our as yet moonless planet as conceived by the astronomer" At this time, a planetoid, passing comparatively near to our rapidly revolving earth, set up the necessary gravitational force which wrenched away three quarters of the earth's crust For millions of years, this material surrounded the earth in the form of a ring like that of Saturn Later, this ring coalesced to form the moon

When the catastrophe that gave birth to the moon took place, a scar of some sort would have been left on the earth, and Pickering sets out to see if he can find that scar

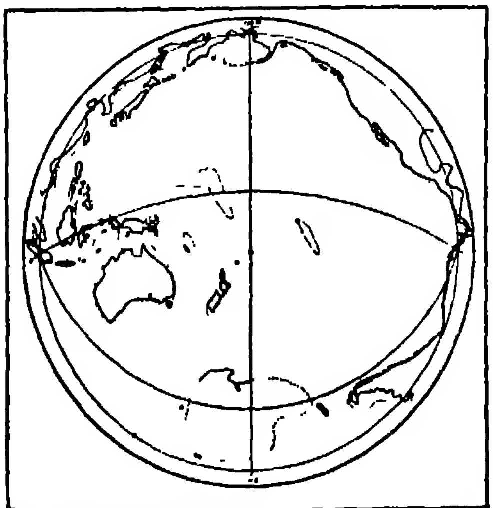
The outer crust of the earth is lighter, less dense, than the inner parts on which, according to the accepted theory of isostasy, it floats The density of the moon, which is known, corresponds closely to that of the earth's outer thirty six miles Was the moon once part of the earth's outer crust?

Professor Pickering's map of the earth's oceanic hemisphere, shown in the left-hand column, supplies a strong suggestion in that direction "The volume of the moon is equivalent," he says, "to a solid whose surface is equal to that of all our terrestrial oceans, and whose depth is thirty six miles" The inference is plain When three-quarters of the earth's outer layer was torn away from the earth, the remainder of the crust may have been broken in two Having been summarily split by this stupendous event the continents, floating in the denser, heavier rock below them, then drifted apart like ice flows

We Barely Missed Being Fish

To the moon, Professor Pickering points out, we humans owe our very existence Have you ever seen the moon through a telescope? To the naked eye, it is a dull, flat, uninteresting disk, but when magnified by a small telescope, it is an exquisite bubble of silver, silently and lightly floating in space—a former fragment of the earth's body which will, according to astronomical theory, return to us millions of years hence

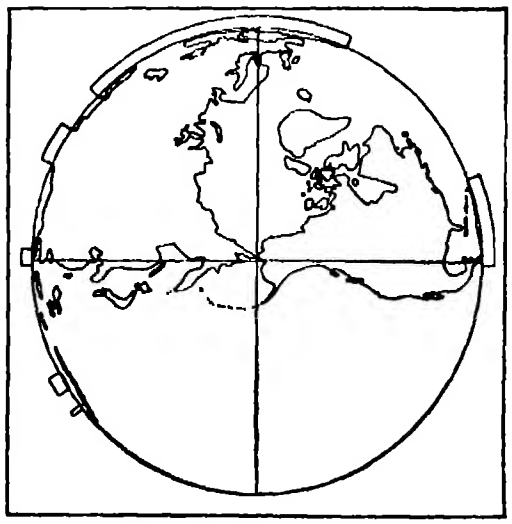
"If it is true," writes Prof Pickering, "that we owe our continents to the moon, then the human race owes far more to that body than we have ever before placed to its credit If the moon had not been formed or if it had carried away the whole of the terrestrial crust, our earth would have been completely enveloped by its oceans, as is presumably the case with Venus at present, and our race could hardly have advanced much beyond the intelligence of the present deep sea fish"



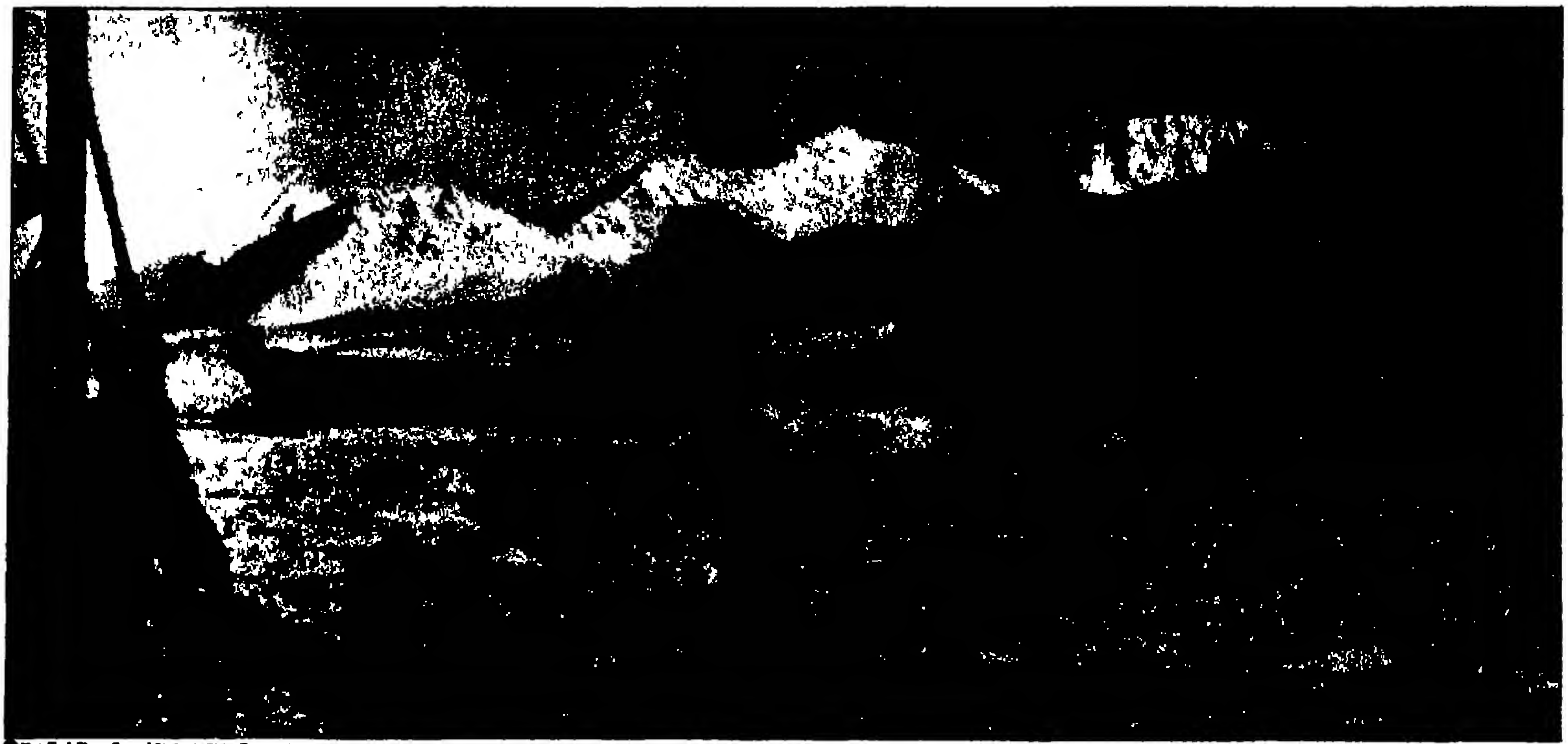
All illustrations courtesy "Journal of Geology"

WAS THE MOON BORN FROM THE PACIFIC?
The oceanic crust areas match the moon in volume

HOW THE CONTINENTS SPLIT ASUNDER
Pickering's map shows how they fit one another



THE LAND AND WATER HEMISPHERES
When the moon departed the remaining crust broke up



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LOOKING OVER THE FROZEN HARBOR TOWARD THE "NORGE'S" HANGAR AT KINGS BAY, SPITZBERGEN

Radio and the "Black" Sun

Invisible Waves Penetrate the Arctic Glow to Tell of Explorers' Historic Triumphs

By Orrin E. Dunlap, Jr.

WHEN the Eskimos become snow blind from the reflection of the midnight sun on the ice, Old Sol looks black instead of like a pale glowing disk and the natives of the north call it the "black light." The radio men who accompanied the aviator-explorers into the polar regions discovered that the "black" sun absorbs energy from the Hertzian waves just as the light of ordinary sunrise, mid day and sunset reduces the range of etherial communication. Therefore, they relied to a great extent upon the short wavelengths, projected high into the upper atmosphere to cut through the glooming of the north with historic messages destined for civilization.

New York to Pole in 32 Days

It was on March 1, 1909, that Admiral Robert E. Peary and a party of seven other men from the United States, together with seventeen Eskimos, 133 dogs and 19 sledges started from Cape Columbia on a hike across the ice sheets and glacier fringes which formed a 423 mile barrier to the prize of three centuries and Peary's dream and goal of twenty years the north pole. Thirty-seven days later, on April 6, 1909, Peary and Matt Henson, a colored follower, stood on the top of the earth One hundred and fifty three days elapsed before Peary reached the northernmost telegraph station at Indian Harbor, Labrador, from where he announced, "I have the pole"

In sharp contrast with this, seventeen years later, Commander Richard E. Byrd of the United States Navy and his American pilot Floyd G Bennett, hopped off from Kings Bay, Spitzbergen, in a Fokker three-engine plane, the *Josephine Ford*, on May 9, 1926, at 12 50 A M, Greenwich time At 4 20 P M. of the same day they returned to their base, having circled the pole and made the dash back in 15 hours and 51 minutes The round trip measured 1,360 miles

Dispatches were soon vibrating the ether between the transmitter at Spitzbergen and the receiver at Loeddington, Norway, connected by land wires with the powerful transatlantic station LCM, Stavanger, Norway, whence the news was broadcast to America Little time elapsed before radiophone stations throughout the country were interrupting their programs of Sunday evening entertainment to announce "Byrd flew across the north pole and returned to Spitzbergen The trip was successful"

Byrd's expedition, said to have been one of the best equipped that ever set out to conquer the arctic, departed from New York City aboard the S S. *Chantier*, April 7, 1926 Thirty-two days later the plane flew over the polar scenery and verified Peary's observations, that an expanse of broken ice stretching as far as the eye could reach in every direction surrounded the top of the world, and that no life, not even a bird, polar bear or seal was seen It was merely a matter of minutes for radio reporting to spread this news around the world.

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THE HOP FROM KINGS BAY

Commander Byrd and Pilot Bennett leaving for the north pole in their three-engine Fokker plane

In contrast to this, Peary's trip from the time he set sail from New York City aboard the polar ship *Roosevelt*, on July 6, 1908 took 429 days He carried no wireless equipment and was out of touch with civilization during his sojourn in the ice fields

Short Waves Overcome Absorption Effect

Byrd's plane carried a radio transmitter designed by Malcolm P Hanson of the United States Naval Research Laboratory, consisting of a single 50-watt crystal-controlled transmitter developing about 30 watts in the aerial It was tuned to operate on the 44 and 61-meter wavelengths. The airplane receiver was a short-wave, three-tube circuit built to pick up the signals from the base ship *Chantier*. The flyers did not attempt to use the radio during their dash to the pole because they were too busy using their bubble sextant, sun compass and three magnetic compasses as well as navigating the plane.

While the Fokker was in the air, the operators on board the *Chantier* maintained a constant watch tuned in on the 44-meter wave so that they would be ready to intercept messages in case the plane was forced to land. At other times, the operators listened, during American night hours, for signals from amateur stations. According to Malcolm P. Hanson, who crossed the Atlantic on the *Chantier* to install and test the equipment, it was found that the 20-meter waves were most efficient as a means of overcoming the absorbing effect of the light rays.

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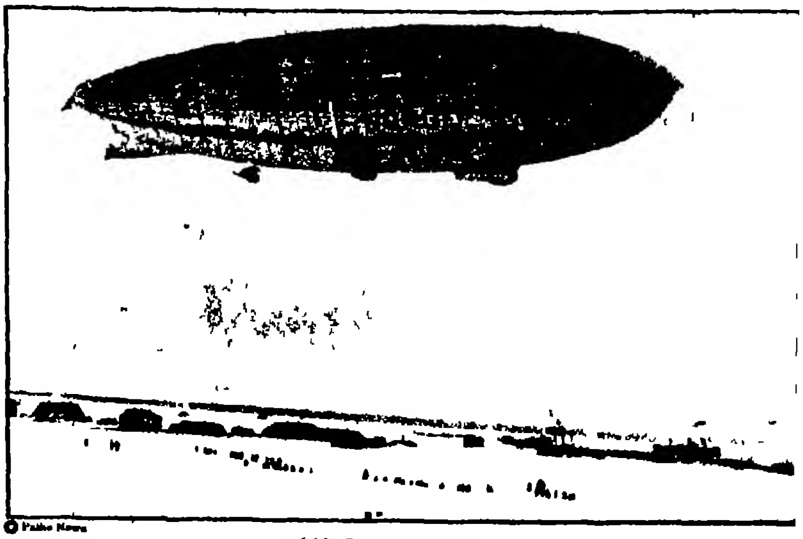
MAIN STREET, KINGS BAY

The village from which both Byrd and Amundsen started for the north pole



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OFF FOR THE POLE

The vertical radio aerial is suspended from the bow of the polar airship

He reported that the 40-meter waves were received with good intensity but that they were erratic and less dependable than the 20-meter signals. On one occasion the operators of the *Chantier* talked with an amateur in New Zealand and with another in Brazil. The Brazilian impulses were so loud that the operators thought the station was in France, the shores of which were only a few hundred miles distant. The 32.79 meter waves of station 2XAF, Schenectady, New York, were heard with good intensity. They faded only slightly when the *Chantier* was 400 miles west of Scotland and at Kings Bay.

"Norge" Sends First Message from Pole

Mr. Hanson explained that the well modulated 500-cycle note of NKF, the Naval Research Laboratory at Anacostia, District of Columbia, was best read as long as it could be received by a non-oscillating, regenerative circuit. The amateur transmitters which were heard best, had as a rule, a raw 60 cycle note, which broadened the tuning to such a degree that the rolling of the ship did not affect audibility. He said that the amateurs in the New England states were surprisingly predominant.

Two days after Byrd's visit to the pole, the Amundsen-Ellsworth Nobile expedition cast off from Kings Bay in the Italian built dirigible *Norge* bound for Alaska via the north pole. Soon after the big ship was floating over the ice fields, Captain Birger Gottwaldt, wireless expert of the expedition, dropped the 300-foot aerial wire through an insulator in the deck of the cabin, with a sinker on the end to keep the wire taut. Immediately radio began to furnish a running story of the flight and shortly after 1 A.M., Greenwich time, on May 12, 1926, the first message ever received from the north pole reached the operators at Spitzbergen. It read, "We reached the north pole at 1 A.M. today and lowered flags for Amundsen, Ellsworth and Nobile."

The next message was radiated at 3.30 A.M., when the 200-watt transmitter flashed: "Lowering three flags, Norwegian, American and Italian, when the *Norge* was over the north pole, was the greatest of all events of this flight. Riiser Larsen's observations showed that we were over the pole. The *Norge* descended and speed was reduced, when the flags were lowered over the wastes whose edges gleamed like gold in the pale sunlight, breaking through the fog which surrounded us. Roald Amundsen first lowered the Norwegian flag. Then Ellsworth, the Stars and Stripes, finally Nobile, the Italian flag."

The *Norge* then proceeded to fly over the "Unknown Continent," between Alaska and the pole which man had never explored. After a 3,291 mile cruise of seventy-one hours the dirigible came to earth on May 13 at 8 P.M., Alaska time, at Teller, Alaska, ninety-one miles west of Nome.

After the *Norge* passed the pole, great difficulty was encountered in operating the radio apparatus because ice coated the aerial wire and the windmill driver of the generator, which supplied the electrical energy to operate the transmitter and charge the storage batteries. Efforts were made to establish communication with Alaskan stations but with no success. Then when the airship sailed over Alaska the heavily iced aerial bumped along the ground when the craft descended to a low height to ascertain her position. Ten hours before landing at Teller, Gottwaldt picked up two different Alaskan stations and took bearings on them by means of the direction finder. These proved to be of great assistance.

Amundsen Lands Safely at Teller

The direction finder consisted of two double loops placed at right angles to each other outside the envelope of the airship, each loop being at an angle of forty five degrees to the keel of the craft. They were connected to a Marconi direction finder and to a radio goniometer and search coil, which were in turn connected to the tuning circuit designed to cover a wide band of wavelengths.

After landing at Teller, Gottwaldt fixed up the old spark station which he found there and twenty-four hours afterward had established communication with Nome. Within a few hours the anxious world was reading the news that the *Norge* and its intrepid crew of birdmen had landed safely.

Photographs from Wide World and Herbert Photos

THE RADIO OPERATOR AND EQUIPMENT OF THE *NORGE*

LEFT: *The receiving set with its three sets of coils covering 300 to 25,000 meters.* **INSERT:** *Captain Birger Gottwaldt, radio operator.* **RIGHT:** *The simplified radio transmitter*

All photographs courtesy the Viscose Company

WHERE THE ENTIRE PROCESS IS CONTROLLED

Each step must be analyzed constantly in the chemical laboratory lest the strands vary in thickness grow harsh or weak or turn out to be something that is not rayon at all and that is entirely unsatisfactory for commercial use The chemist is, then, the guiding light of the entire industry and is responsible for the finished product

The Latest Member of Our Textile Family

Rayon, Although Commercially Unknown Thirty-five Years Ago, Has Come Into General Use Today

By N A Parkinson

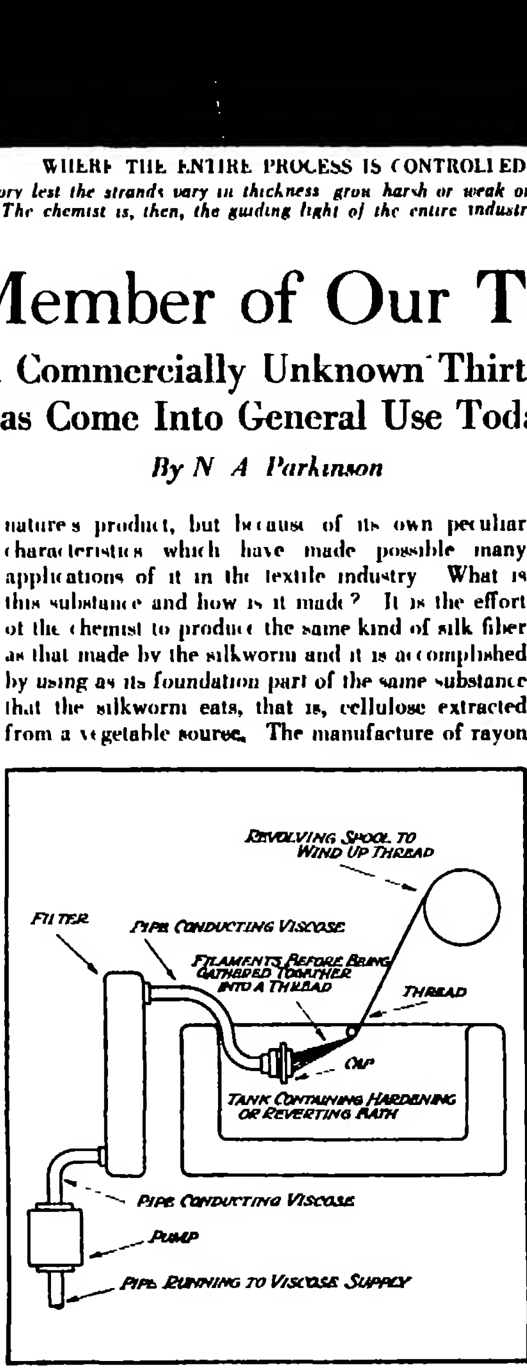
THE chemist is fast becoming master in his own house Everywhere about us are manifestations of the part he has played in making this world a safer saner, and better place in which to live Yet how many pause to consider that the chemist is a very real and dominating factor in contributing to our modern day conveniences and comforts? Let us take, for example, but one achievement of the chemist—the manufacture of artificial silk, now called rayon, in which he has triumphed over Nature

Although the imitation of silk was suggested by a French scientist as early as the middle of the Eighteenth Century, it was not actually accomplished until 1884 when Hilaire de Chardonnet patented a process for the manufacture of artificial silk And it was not until 1891 that artificial silk was produced on a commercial scale The industry languished for awhile, but not so the chemist He was ever on the alert, always hunting and searching for some way, either chemical or mechanical, to improve his product, and now, after thirty five years of painstaking research, his efforts have been crowned with success and the world s output of rayon is greater than that of natural silk

Machine-Made Cocoons

For a long time this man made silk suffered by being known under the misnomer, artificial silk, thus following in the footsteps of cotton which was first introduced to the world as a species of wool But within the last few years the French name, rayon, signifying ray—something light and bright—was happily applied to this invention of the chemist, and has now been generally accepted

Rayon has found a place of its own in the industrial world, not because of its resemblance to nature s product, but because of its own peculiar characteristics which have made possible many applications of it in the textile industry What is this substance and how is it made? It is the effort of the chemist to produce the same kind of silk fiber as that made by the silkworm and it is accomplished by using as its foundation part of the same substance that the silkworm eats, that is, cellulose extracted from a vegetable source. The manufacture of rayon requires chemical and engineering skill of a high degree A delicate and extremely accurate control of all the processes through which it must pass is absolutely essential



SPOOL SPINNING

The viscose is forced through a plate pierced with fourteen or more minute holes and immersed in an acid bath that hardens it immediately The thread is then wound on a spool and is soon ready for use in the loom

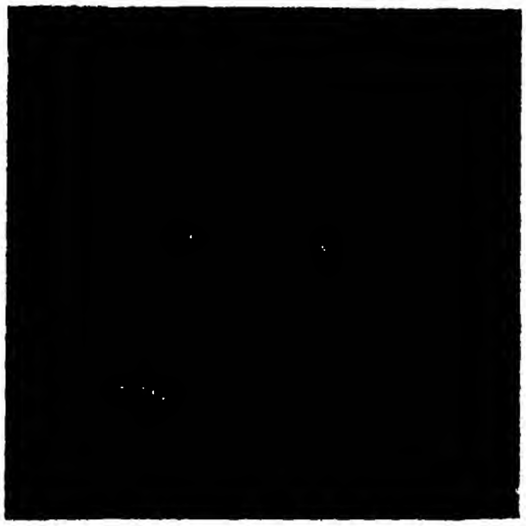
There are four different commercial processes for the manufacture of rayon, all using as a basis chemically purified cellulose, whether obtained from wood or cotton, but more than three fourths of the world's output is made by the viscose process

The manufacture of rayon may be likened to the silkworm spinning its cocoon Just as the silkworm ejects from its mouth a viscous substance which hardens immediately upon contact with the air, so likewise do mechanical spinners, after subjecting the cellulose to various chemical treatments, finally send forth very fine streams of viscose, which harden into silk threads of any desired length, thus differing from those of the silkworm whose threads average five hundred yards in length

Rayon Fibers More Uniform Than Silk

The fiber of the silkworm is never uniform, while that made by man is of equal diameter and strength throughout its structure. This is because the silkworm does not move with the mechanical precision and regularity of man-made spinners, nor does it eject the viscose substance from its mouth in the constant stream, with the unvarying force and at the unchanging rate of speed that is possible when mechanical regulators are employed.

When the solution goes from the chemical plant to be spun into fiber and thrown and reeled into its various forms, its chemical characteristics determine its strength, quality and appearance. If there has been the slightest deviation from prescribed procedure in any of the operations through which it has passed, the solution may be rendered impotent for



THE RAW MATERIAL ARRIVES
Spruce wood or cotton has been treated to remove the gums and resins and arrives in the form of sheets

later manufacture into fiber, yarn, finished textile, and so forth. The finished product is soft and flexible, and is noted for its fine luster, uniformity and adaptability to dyeing processes.

The first step in the manufacture of rayon is that of cooking the raw stock, spruce wood or cotton, by the aid of live steam, in a large boiler or digester. With the assistance of chemicals, this cooking removes resin, gums and other foreign matter from the natural cellulose. After leaving the digester, the mass is bleached to bring it to a proper degree of whiteness.

At this stage, the cellulose consists of tiny fibers which are now run through a series of rollers to squeeze out the water. These rollers compress the fibers into sheets, each of which is about the thickness and consistency of blotting paper. The general procedure in preparing the cellulose sheets is similar to that used in pulp and paper making.

From Cellulose to Rayon

The large sheets are now cut to twelve-inch squares and are soaked in a solution of caustic soda for about twenty-two hours. Hydraulic presses then force out the excess liquid. The sheets are cut into small particles by revolving knives and kept in especially constructed containers at an even temperature for about forty-eight hours. This is called the mercerizing process.

The product, now called alkali-cellulose, is placed in a revolving churn together with a certain predetermined amount of carbon bisulphite. The mixture is revolved slowly for two to three hours, forming cellulose xanthate. This is a plastic substance, light orange in color, and it can be dissolved readily in water.

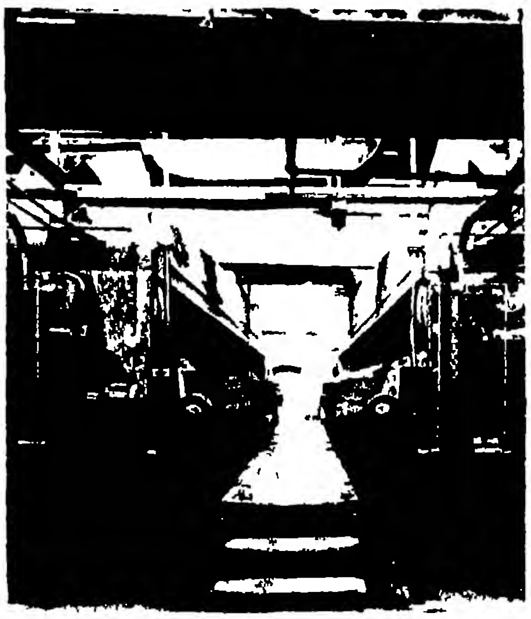
PREPARING TO MERCERIZE
The large sheets are cut into twelve-inch squares and soaked in a caustic soda solution for 22 hours

The cellulose xanthate, with a weak solution of caustic soda, is placed in a machine with rapidly revolving blades which beat it thoroughly and mix it into a uniform mass. This mixing operation is the final process in converting the cellulose to the liquid called viscose. Viscose, derived from the word "viscous," resembles molasses in color and consistency.

Before the viscose can be spun into threads, it must be aged by standing in large vats or tanks at an even temperature. Before leaving the aging cellars for the spinning room, it must be filtered carefully to remove all dirt or foreign matter which may have accumulated.

Now comes the spinning of the viscose into threads, the first real evidence that fabric is to be produced. The secret of forming the filaments of thread is that the viscose solution is a strong alkali that hardens upon coming in contact with acid.

Simply stated, the mechanical part of the operation consists of forcing the viscose through a plate containing fourteen or more holes which is immersed in an acid bath. Upon leaving the plate, the streams of viscose immediately harden into long thin strands before they have time to run together again. The holes in the plate, through which the liquid is passed, are from two to five one thousandths of an inch in

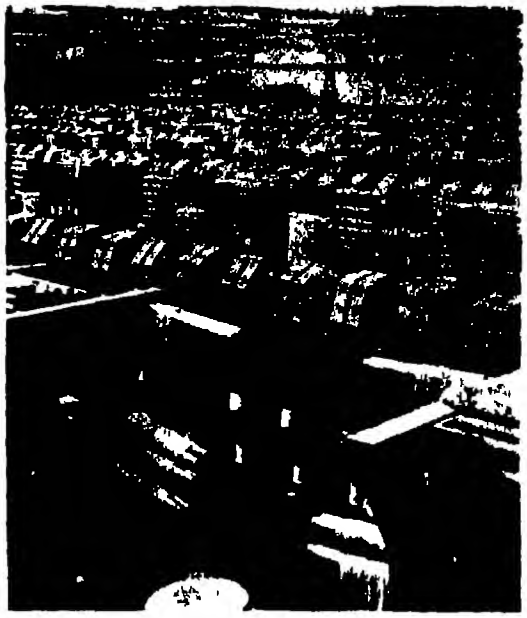


THE MECHANICAL SILKWORMS
These are the machines in which the viscose is formed into filaments that are then twisted into thread form

diameter, invisible to the naked eye unless held before a strong light.

A revolving spool gathers the filaments together and winds them into thread. There are two methods of doing this—spool winding and box spinning. In the first method, the filaments are grouped together to make up a thread which is immediately wound on a spool, rotated at a regulated number of revolutions per minute. The thread is wound in parallel filaments in a semi-gelatinous state, requiring further hardening by chemical treatment, followed by a thorough washing after which it is finally dried. The filaments, although delicate, form a substantial thread when grouped and slightly twisted together. The twisting operation consists of unwinding the filaments from the first spool and by the aid of a rapidly revolving spindle, putting in the desired twist while winding on another spool. It is then reeled from the second spool into the form of skeins.

In the box spinning method, the separate twisting operation is eliminated. Upon leaving the perforated plate, the filament passes over a revolving wheel and drops through a glass funnel into a revolving box. A twist is put into the strands between the pulley and the lower end of the funnel. The box is revolving and the centrifugal force throws the thread to the sides of the box and causes it to form a coil in the shape of a short, hollow cylinder about an inch across, the outside diameter corresponding to the inside measurements of the box. This package of thread is then to be wound into



REELING INTO SKEINS
The standard rayon skein is 44 inches in circumference. Washing and drying is done when rayon is in skein form

skeins, the standard rayon skein being 44 inches in circumference.

After a final washing and drying, the cellulose is back in the original pure dry state in which it entered the first or mercerizing step of conversion only instead of being in the shape of a sheet, it is in the form of a brilliant, lustrous thread, called rayon.

Rayon is, then, a vegetable fiber, analogous in composition to cellulose, whereas the fiber of the silkworm is of animal origin and contains nitrogen. Its strength, when dry, however, is only about half that of natural silk of the same size. When wet, it loses a large part of its strength, and it is because of this that care should be exercised when laundering rayon fabrics. Water of any degree of temperature may be used without fear that the garments will turn yellow. Soaps or compounds appropriate for silks or woolens are suitable, and starch may be used, as with cotton goods.

Has a Marked Affinity for Dyes

Rayon always retains its luster, and if it is carefully handled while wet it will regain its original strength when dry. Its filaments are continuous and smooth. Hence, there are no fibers to rough up as on worsted, linen, and cotton materials.

At one time it was feared that the rapid growth of this young industry might result in an oversaturated market. Apparently there is nothing to fear in this regard. Its steadfastness of color, its luster, and its affinity for dyes have multiplied its uses and usefulness. It has worked wonders in the knitting business. By merely combining a few strands of rayon with wool, a beautiful luster was imparted to the material. Almost overnight the demand was greater than the supply.

The union of rayon with other textiles has supplied some of our most attractive fabrics. Take, for example, the cross-dyed silk patterns, where the

SORTING AND GRADING
The material is graded according to detected defects

vegetable fiber of rayon takes one dye while the animal fiber of silk takes another, producing an attractive fabric. This is also true of wool, the rayon usually manifesting itself in stripes or plaids. Cotton and rayon take the same dyes, cotton forming the base and rayon furnishing the lustrous surface

The hosiery industry uses the greatest percentage of rayon at the present time, with the cotton industry as a close second It is also used extensively in underwear, laces, linings, sport goods, umbrellas, raincoats, shoe coverings, ribbons, gloves, millinery braids, trimmings, and in many other fabrics Its use in underwear is finding wider application since it has been demonstrated that it absorbs moisture from the body and at the same time permits the evaporation of the excess moisture Formerly the impression was quite prevalent that rayon was inflammable, but this has been disproved

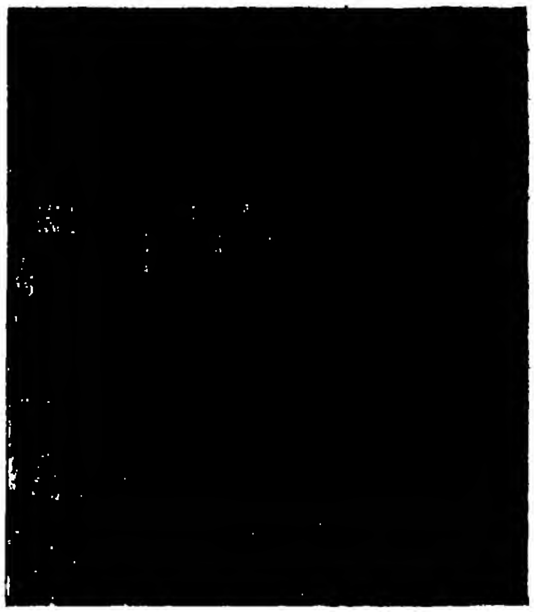
Rayon has revolutionized the world's textile market. The industry is now well established in France, the place of its birth, where it was practically boycotted by other branches of the textile industry until 1923 The knitting industry then increased its consumption until domestic production in 1924 was three-fifths greater than that of 1923 and imports of rayon yarn were considerably more than doubled. There are now more than fifty plants producing rayon in France, and yet consumption has increased to such an extent that although in 1925 France ranked fifth in world production, with an output of nearly fourteen and one-half million pounds, it was inadequate to meet domestic requirements.

Textile manufacturers have not only bowed to the inevitable and accepted rayon, but are manifesting great enthusiasm in combining it with other fibers. It is one of the important textile industries in England Recently the biggest English producer started a branch in Canada, where the abundance of wood seems to indicate that we may look for large-scale production. In Germany, the old munition works have formed the nucleus of the industry, which is now reported to be in a better condition than her other textile industries

China and Japan Using Rayon

The output of Belgium has been absorbed at home, and Switzerland is gradually finding more extensive use for rayon. The development of the artificial silk industry in Italy has been phenomenal The Italian product is not of the highest quality, but much of this is overlooked because of its market selling price. The claim has been advanced that Italy is seeking world conquest of the rayon market Statistics show that in 1925 she occupied second place in world production The South American countries, while not producers, are large consumers of rayon. Even the Far East is following the example of the rest of the world and is turning to artificial silk.

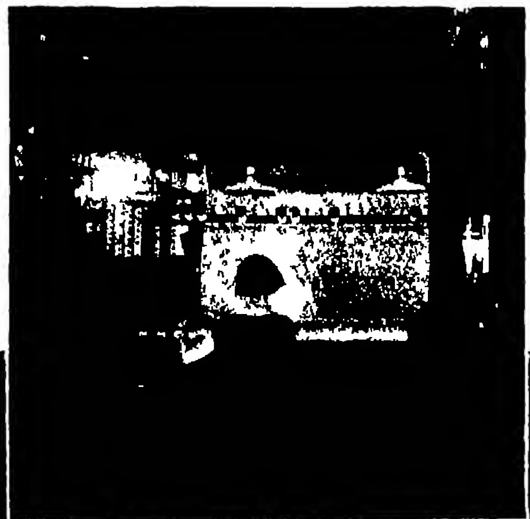
China, the home of the natural silk industry, affords a growing market for rayon, as does India, and rayon is making rapid progress in its invasion of Japan. America, because of the superior quality of the product her chemists produce, is able to compete with cheaper foreign labor, and leads the world in consumption as well as in production In 1925 about one-third of the rayon produced in the world came from the United States, or nearly 55 million pounds

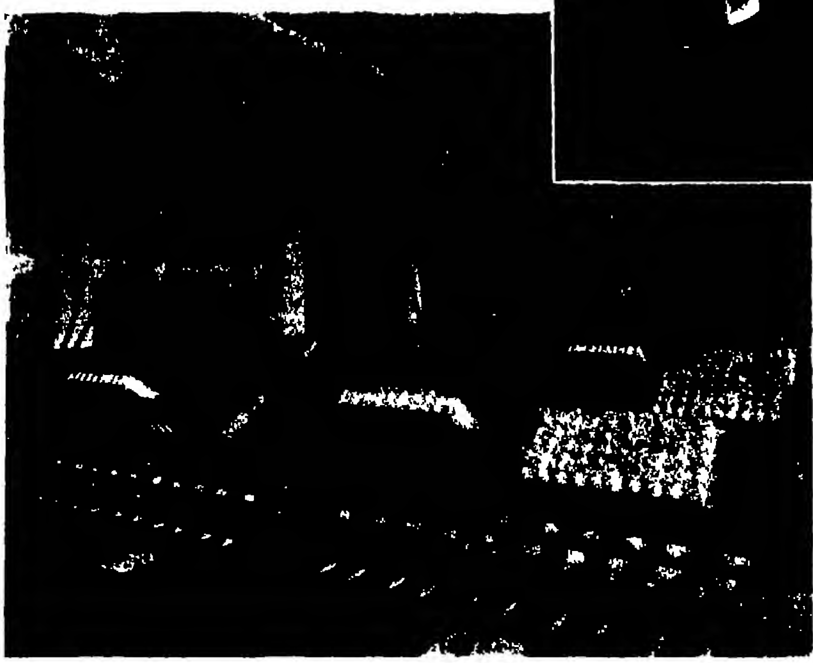


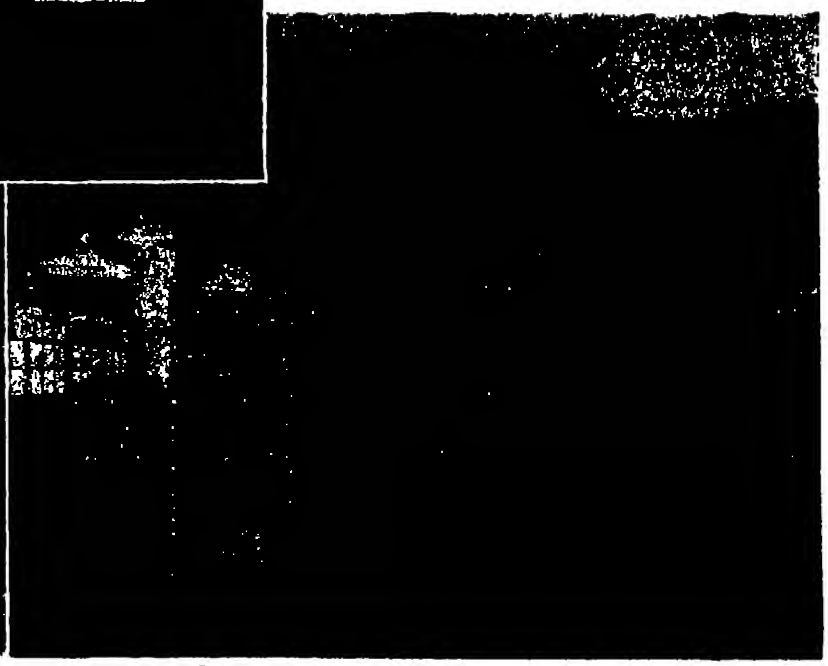
THE SPOOLING DEPARTMENT
Here the rayon is wound from the skein reels to spools

In the end, probably the whole question narrows down to price Its low price, as compared with that of natural silk, has given it an unquestioned place in world markets Unlike most other textiles, its price has been stable both during and since the World War It is made from cellulose, which is the chief constituent of all plant life, so no matter what ills may befall its sister industries, rayon will always have an inexhaustible source of raw material upon which to draw. Its price should always be as nearly stable as it is possible to make any price, and not subject to market fluctuations and the like

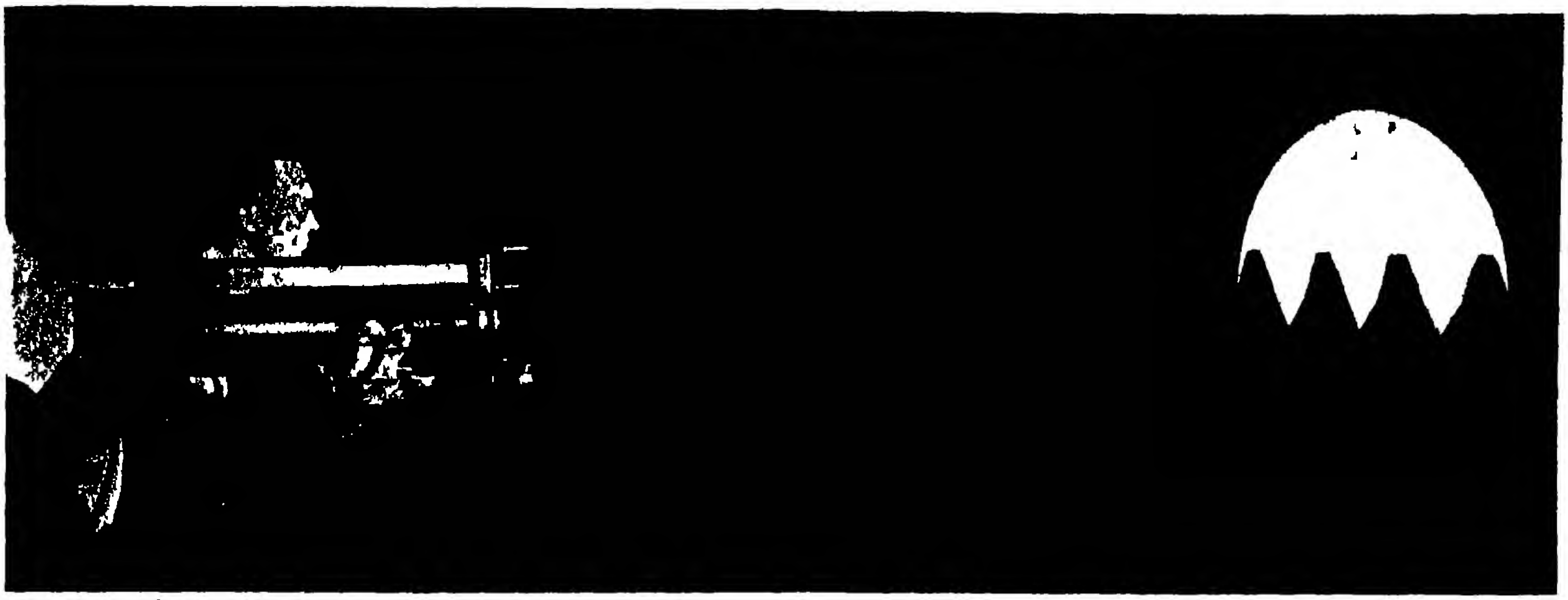
When rayon is mixed with other fibers, its presence should be made known to the purchaser. It is not a competitor of silk, linen, wool or cotton Instead, it is being adopted by these other textile industries as an integral part of their products and is establishing a firm place for itself







PREPARING THE FINISHED RAYON THREAD FOR WEAVING
LEFT: *The rayon threads are transferred from the spools to the weft form for the weaving loom* RIGHT: *Other spools of thread are rewound on the creels or drums which are to furnish the warp.* INSERT *From the creel, the warp thread is drawn on the loom beam which then is placed on the loom and the weaving started*



A PROJECTION OF A COMMERCIAL SCREW THREAD WHICH SHOWS THE IMPERFECTIONS IN THE FORM. IN THIS CASE THE THREAD IS AT AN IMPROPER ANGLE

Scientific Accuracy a Commercial Necessity

The Contour-Measuring Projector Aids Inspection of the Finished Product

THE demand for greater and greater accuracy in manufacturing has brought into existence within recent years many machines of remarkable precision for quantity production of interchangeable mechanical parts to meet the demand for closer and closer tolerances and more exacting material requirements.

Precise parts made to a close limit of accuracy assure proper functioning, maximum strength and wear—in short, highest value and lowest ultimate cost—of the completed products.

The adoption of accurate machines in modern manufacturing processes is one of the most significant developments of modern industry. The investment in machines for the production of standardized mechanical parts and in facilities for rigorous inspections proves the importance of making the various mechanical parts to very close limits of accuracy throughout the manufacturing processes.

The successful use of machines for quantity production of interchangeable parts depends upon correspondingly accurate tools for making these parts and upon efficient means of measuring and inspecting both the tools themselves and the finished work.

The contour measuring projector throws a highly magnified image of the profile of the part under investigation by optical projection on a chart or screen.

An error of only a thousandth of an inch appears a quarter of an inch in size under a magnification of 250 diameters, and an error of one ten thousandth is readily discernible.

The scope of the work to which this instrument is adapted is very wide. New uses are being found almost daily and it has proved its value in such work as tool cutting, gear making, screw thread cutting and in making automobiles, electrical goods, phonographs, sewing machines—in fact in the making of a long line of manufactured articles from clocks and watches to engines and pipe fittings.

What the Apparatus Is

The projector is both a microscope and a projection apparatus of the highest quality combined in a sturdy efficient device for machine shop and factory. It is accurate enough for the most exacting laboratory tests and yet simple enough to be used by any competent workman without special training.

Briefly described, it consists of a highly perfected optical system and suitable mechanical parts to protect and support the optical system, to hold the work in proper position, and to provide all necessary adjustments, and means for making accurate measurements.

The lamp house, condensers, compound microscope and right angle prism are all in fixed relation to each other so that at all times the entire optical system is centered about one single axis and the screen receiving the image is always perpendicular to this axis.

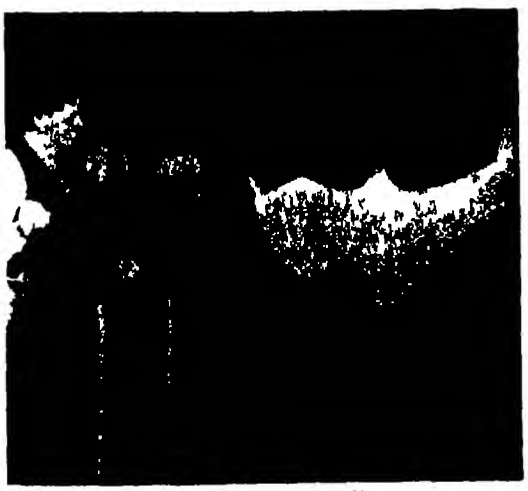
When used as a thread projector the entire optical system is turned to an angle equal to the mean helix angle of the screw. This method of screw thread projection has a number of very marked advantages over the other possible method of projecting the image of a screw thread, with the axis of the screw perpendicular to the axis of the optical system.

The centered optical system as used gives images which are the best of which lenses are capable, whereas in an uncentered system which would be necessary if the axis of the screw were at right angles to the light beam, the image would be formed by oblique pencils of light passing diagonally through the objective. This would result in a decidedly inferior image. When this optical system is turned through the mean helix angle the outline of the image differs in shape from the contour of the thread by a very small but definite known amount for which the correction can be easily applied. With the centered optical system there is no loss of time in looking for the angle of best illumination as is necessary with the uncentered system.

The work holder consists of two strong supports with adjustable V blocks and accurate centers with bushings and clamps. Work placed between these centers or on the V blocks can be moved in three directions by means of the compound slide up and down and sideways to bring it accurately into the path of the light and backward and forward to focus the image of the work on the table or screen.

The centers will accommodate a wide range of work such as screws, hobs, cutters and gages. If the work is too large and heavy to be held between the centers these may be removed and the work may be placed directly on the V blocks.

The demand for scientific accuracy is coincident with any consideration of cost reduction and therefore vital to every manufacturer.

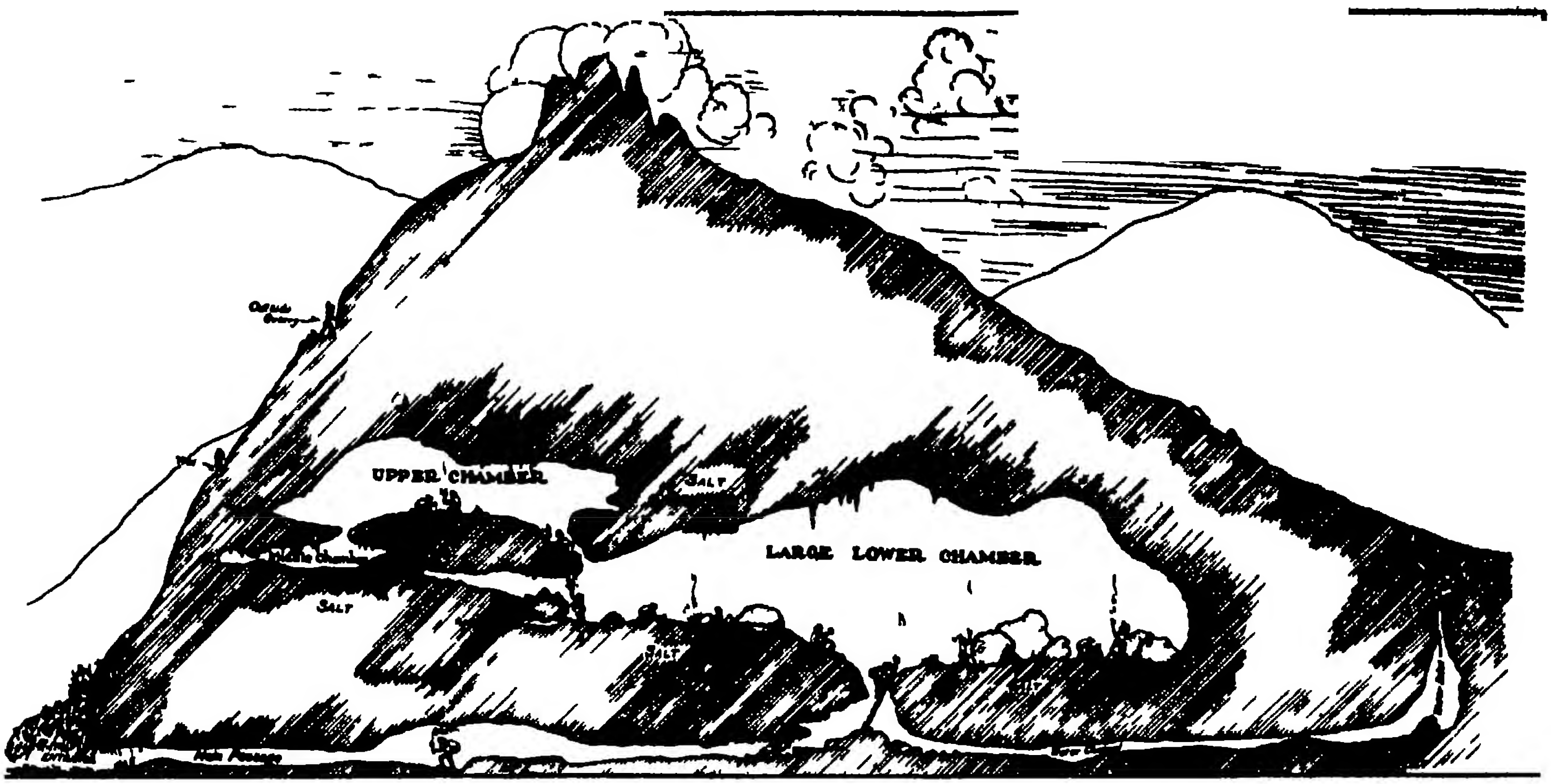


IN A CAN FACTORY

Extremely accurate inspection of the sealing rolls is necessary. Here we see the projector in use

INSPECTING A GOVERNOR SHAFT

An error of 1/1000 of an inch appears to be ¼ of an inch under a magnification of 250 diameters



A CROSS SECTION OF A SALT HILL SIX MILES SOUTH OF ST THOMAS NEVADA

Ancient Salt Mines of the Indians

In Nevada a Cave with Peculiar Markings Made by Man Has Turned Out to Be a Salt Mine of the Indians of Two Thousand Years Ago

By M R Harrington

Archeologist in charge of the Nevada Expedition of the Museum of the American Indian Heye Foundation

THAT mines were operating in Nevada many centuries before the days of Aurora and Pioche—of Virginia City Tonopah and Goldfield is one of the interesting discoveries made by archeologists now delving in the ruins of Pueblo Grande de Nevada popularly known as the "Lost City" in the southern part of that state Many centuries is putting it mildly for the finds show that mining was in progress about the beginning of the Christian Era some twenty centuries ago and there are indications which point to work at an even earlier period

A Mystery to Be Solved

It was a salt mine or rather a series of salt mines that has just been explored by the expedition sent out by the Museum of the American Indian Heye Foundation, of New York City working in cooperation with the State of Nevada The principal mine is situated in a peak of solid rock salt owned by the Virgin River Salt Company, about four miles south of St Thomas Clark County Nevada and some six miles from the expedition headquarters at the Lost City

The entrance to the principal cavern proved to be through a low tortuous underground passage a natural drainage channel which may be followed completely through the mountain But we left it about a hundred yards from daylight clambering up out of it into a series of vaulted chambers hot, dark and silent and smelling strongly of bats

Turning our lights upon the wall we were astonished to find them covered with markings apparently made by the hand of man—curious circles and ovals a foot or so across outlined by grooves cut into the salt Some were separate some overlapping and some strung together like links in a chain and all were especially numerous wherever the salt outcrops seemed purest What could they be? Were they ceremonial symbols of some sort? Certainly they were utterly unlike any of the several types of ancient rock writings or petroglyphs we knew to be characteristic of the district

We looked about us for evidence bearing on the problem and observed that the floor of the chamber where we stood was covered with a dry dusty deposit Surely if human hands had carved the circles a great many hours must have been spent in the work and the carvers must have left some traces of their visit in the loose deposit underfoot—traces that an archeologist might interpret and from which he might hope to learn the identity of the carvers even perhaps the purpose of the carvings So we applied for and obtained permission to investigate the caverns

A PEAK OF ROCK SALT
Below the towering battlements can be seen the opening to one of the large salt mine tunnels

The Mystery Is Solved

The systematic digging had not proceeded far when it dawned upon us that the place was nothing more nor less than an ancient salt mine and that the deposit was merely a mass of salt mine refuse consisting mainly of discarded salt, ranging from large chunks down to dust and profusely perfumed with bat droppings and somewhat mixed with other things

We were led to this conclusion first of all by the finding of hundreds of stone picks and hammers scattered throughout the mass which surely were not there by accident The picks were waterworn boulders six or eight inches long, with one end chipped to a point They had evidently been held in the hand Some of the hammers had been held in the hand also, but most of them were provided with notches or with rude grooves for the attachment of wooden handles, while a few, to our astonishment and delight, still retained their wooden handles in perfect condition, due to the dryness of the cave plus the preservative action of the salt

We finally learned the significance of the myster

WALL OF AN ANCIENT MINE
Note the circles made by the prehistoric salt miners

ious circles which had puzzled us at first, when we reached the original bottom of the cavern, a ledge of solid rock salt, and carefully laid it bare. It was covered with just such circles and ovals as those we had seen on the walls, but with every little mark and detail beautifully preserved by the dust and refuse that had covered them.

When we examined these carefully, we found that the circles had been carved into the salt with the stone picks, grooved around and around, deeper and deeper, until a raised circular block of salt was left in the center. Then this block had been broken out with the stone hammer to be taken home by the miner. We were able to prove this by fragments of just such salt blocks, found in the mine refuse, which showed parts of the encircling groove with the marks of the stone pick still plainly visible.

After the excavation was finished, and we had laid out and classified all the specimens we had found in the cave, we discovered that nearly everything we had found had to do with salt mining, directly or indirectly.

First of all there were the stone picks and hammers already described, actually used in getting out the salt. Then there were numerous fragments of wooden hammer handles, and quantities of strings, made of yucca fiber and of Indian hemp, which had served as wrappings for the handles, and to bind together brush torches. There were many sticks from the torches themselves, burned at the ends, also torches made of shredded bark, all used to furnish light for the miners at their work, while larger burned sticks and beds of ashes suggested that fires had sometimes been built on the cave floor for this purpose.

Various digging sticks, bearing the marks of long use, had probably been employed to dig away the refuse accumulated over the outcrops of salt to be mined. One neatly made little brush of fiber doubtless served to sweep out the grooves as the work went on.

So much for the tools of the ancient miners. Other relics had to do with their clothing. Most interesting of these were the sandals—thick, with pointed toes, neatly woven of yucca fiber and showing the wear of long use. One was complete, even to the strings. There were strands from fur-cloth and feather-cloth blankets, and a little hank of native cotton strings—likely part of a girdle—dyed a rich red. There were also several bits of yarn spun from soft animal hair of some kind, and a number of strings and pieces of flat braid made of black human hair.

Still other articles yielded by the cave deposit told us of food—of the lunches our prehistoric laboring men took with them to work. Most abundant of these were the corn cobs—evidently the remains of "roasting-ears" cooked on the spot. These seem to indicate that several distinct varieties of this thoroughly American plant were grown.

Pottery Determines Age of Mines

We even found a receptacle that had doubtless served to bring someone's lunch into the mine—a netting bag, made from cords neatly twisted from the soft fiber of the Indian hemp, which still grows in the neighborhood. Sometimes, however, the miners must have brought in their lunches in pottery bowls instead of bags, for pieces of several such food dishes were discovered. Water was carried in pottery canteens also, but gourd bottles seem to have been even more popular, if we may trust the number of fragments we found of both.

The question naturally arises—how do we know the age of these workings—how can we tell that the mine was in operation about the dawn of the Christian Era? The pottery tells the story, for the gray ware with patterns in black, dug from the debris of the cave, is identical with that found at Pueblo Grande de Nevada—the Lost City—a few miles away, and was undoubtedly made by the same people. Thus we know that the ancient salt mine was operated by the people of the Lost City, or of one of the related settlements belonging to the same period.

The Lost City seems to have been at its height about the end of the Pre-Pueblo Period and the beginning of the Early Pueblo Period, roughly estimated at two thousand years ago. That the earliest salt workings may be even older may be guessed from the discovery of a fragment of a typical, carved club of the Basket Maker Period, probably antedating the Lost City by another thousand years or so.

ONE OF THE MINE ENTRANCES
This once was the outlet of an underground water course

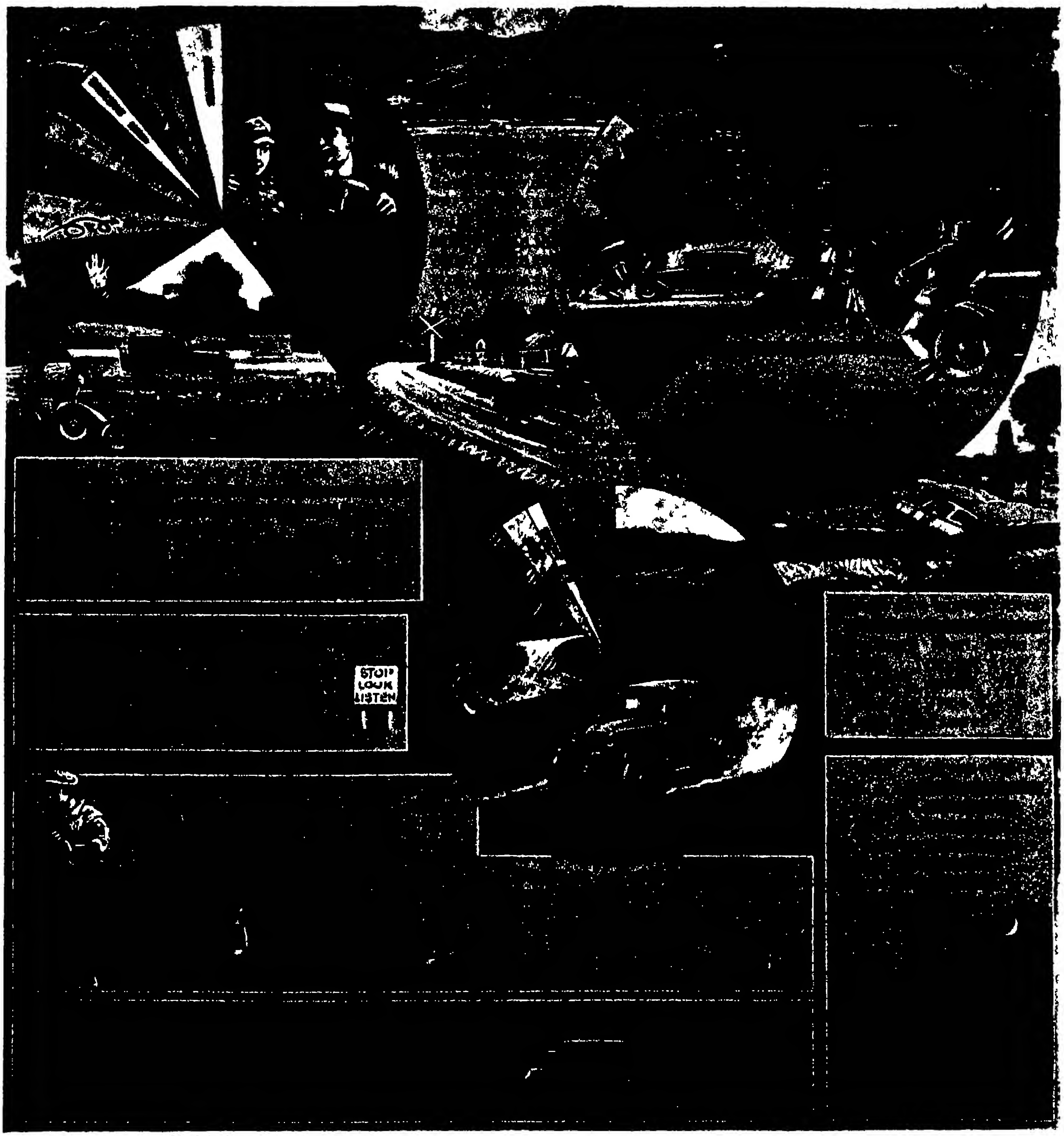
One question remains unsolved. Why did the ancient people choose to work in a dark cavern, when there were various outcrops of salt in broad daylight? We can not explain it on the ground that these open air outcrops now visible were covered at that time, because stone hammers identical with those found in the cave are numerous about them. The outside salt ledges were mined, too.

The only possible explanations which seem to fit the case are: first, that the ancient people may have believed that salt derived from deep in the bosom of Mother Earth was more healthful as food and more efficacious as medicine than the same mineral found on the surface, or second, that each of the Indian settlements of the period owned property rights in the salt, each community having its own particular claim, and that the outside workings were taken up by the first comers on the scene, leaving to bands arriving later only the privilege of mining beneath the surface.

This latter explanation fits in very well with the customs observed until recently at the Sacred Salt Lake near the present Indian pueblo of Zuñi, New Mexico. Here the area suitable for gathering salt has been divided up and allotted to different groups of Indians from time immemorial. This, then, may very well be the solution to the problem of the underground mining of salt.

ANCIENT MINING TOOLS
Here are shown several specimens of stone hammers used by the miners of ancient Nevada for work in the salt mines. The original wooden handles and wrappings are intact

MINERS' PERSONAL PROPERTY
At the left is shown a net bag which was probably used for carrying food. Sandals are shown to the right and several corn-cobs are at the bottom of the illustration



Specially drawn by Arthur T. Merrick for the Scientific American

The Automobile Accident Problem Analyzed

Without figures to guide us, we should say that the majority of automobile accidents ought to happen on a curve in a wet road and at night, but things are not what they seem when the deadly yardstick of statistics is applied. The statistics of accidents in New York State put forth and illustrated above were compiled with great care by an efficient Bureau of Motor Vehicles. This gives an admirable cross section to analyze. The comparisons speak for themselves. There were 47,128 automobile accidents in New York State in 1925 in which 1,981 persons were killed and 54,398 injured. The totals change when we come to certain types of accidents. Thus, pedestrians figured in only 30,811 cases, while 58,444 vehicles were involved. Perhaps the most surprising fact is that railroad crossing accidents numbered only 148 with 75 deaths. To eliminate all the grade crossings in the United States would cost twenty billion dollars, or more than the estimated value of railroad properties. When people talk about grade crossing accidents, they should look at the figures first and count the cost. If everyone would cease jay walking, if children would keep off the roadways and streets, if young men would pet in parlors and drivers would obey the Eighteenth Amendment, a large percentage of our automobile accidents could be avoided and the appalling figures of deaths reduced.

THE COMPLETE MACHINE

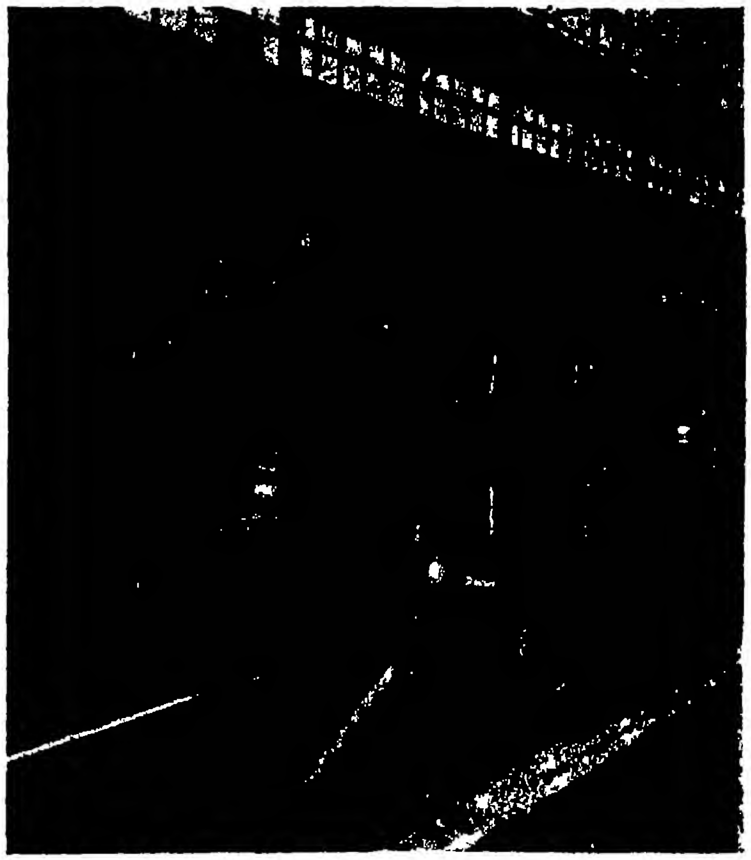
This combined lathe and grinder is entirely operated by motors and is controlled by push buttons which are interlocked to assure safety

THE GRINDING MECHANISM

This complete grinder is entirely self contained and has individual safety push button control It has an extremely long grinding range

SHOWING THE LATHE'S CAPACITY

The 113-inch swing of this lathe is clearly shown above Compare the size of the men in the photograph with that of the huge mechanism



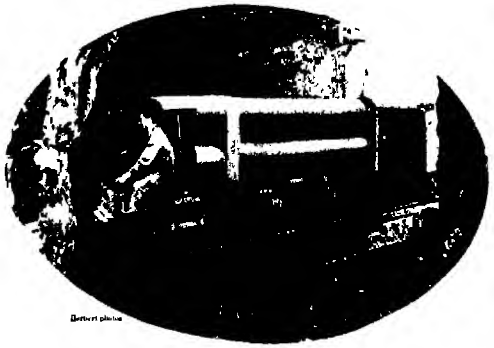
HOW THE CARRIAGE OPERATES

The feed and traverse of this carriage are also motor driven All cutting operations can be controlled from the switchboard shown

A Monster that Answers a Finger's Touch

The vast proportions to which present machine shop practice has developed, is well illustrated in the combined engine lathe and grinder which is installed in the General Electric Company's Schenectady plant This huge machine has a clearance of 45 feet between face plate and tailstock, with a swing of 113 inches over the bed and 94 inches over the carriages It will support a working load of 300,000 pounds On one side of the bed are two tool carriages, each with motor-driven feed and traverse, and on the other side is a complete Landis grinder mounting a 36-inch grinding wheel. Eight motors totalling 139 horsepower are used for the controls, all are of the 230-volt, shunt-wound type. The main drive motor is of 75 horsepower, the two carriage motors are of 10 horsepower each and the grinding wheel motor is of 25 horsepower The others range down to one horsepower A number of trolleys suspended in a pit beneath the bed provide power and control circuits for the traveling members, namely the carriages and grinder bed Push button interlocking control is installed on both carriages, on the grinder and at the headstock Each of these main controls has a "safe" button which can be set to prevent the motor from being started at any station until it is released again at the station where it was originally set The magnetic controllers are therefore interlocked so that in case a tool should gouge in, full field will be applied to the carriage motors, thus slowing them down, while a limit switch prevents the operation of the carriage motors against the traverse

From the Scrap-book of Science—Camera Shots of Scientific Happenings


Herbert photo

A COMPOUND COMPRESSED AIR ENGINE

A modern type of mine mule—the compressed air locomotive. Within the past few years most of the mining operations which were formerly performed by man and animals have been done by power. The locomotive shown employs a triple expansion air engine


Wide World

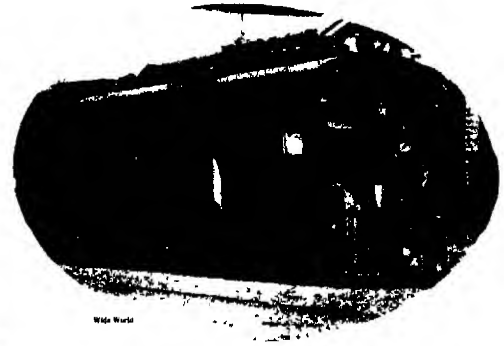
SUGAR FROM ARTICHOKES

In the future when you sweeten your coffee, you may use artichoke sugar or levulose the sweetest of all sugars. This illustration shows the slicing machine devised by the Bureau of Standards for cutting up the tubers of the artichokes after which they are converted into sugar


Acme

A MILE A MINUTE

This new means of water transportation, a gliding ship, recently made its appearance on the Danube River. The boat is equipped with two airplane propellers which are used in the same manner as on an airplane. The ship traveled from Pressburg to Vienna in forty minutes


Wide World

NEW DIESEL ELECTRIC SWITCH ENGINE

In switchyard work, where service is markedly intermittent, the Diesel locomotive is at its best. Between tasks its engines can be stopped and the fuel upkeep reduced to nothing while the steam locomotive in service consumes fuel whether working or idle


Wide World

AN UNDERWATER TORCH

A torch such as this is being used for cutting open the hull of the submarine S-51, which sank last year. The flame is protected from water by a jet of compressed air


Pacific & Atlantic

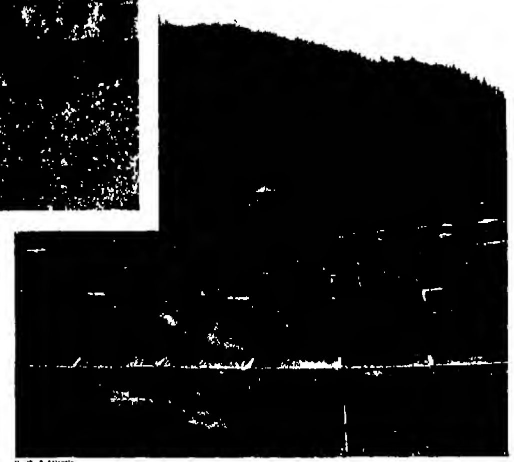
DAMPNESS CAUSES MARBLE TO STREAK

D. W. Kessler of the Bureau of Standards who has been selected to find the reason why marble on some buildings has been streaking. Four miniature marble rooms are used


Wide World

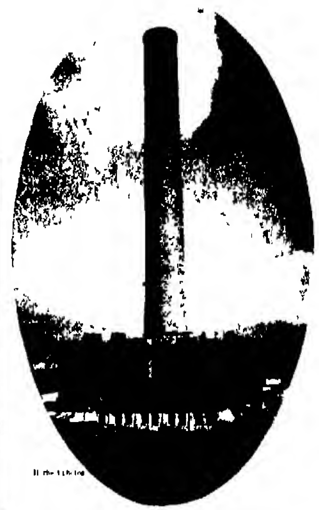
THE ONLY REPTILE IN NEW ZEALAND

Sphenodon, called locally the tuatara, is the only living representative of a large group of reptiles that otherwise became extinct when the great dinosaurs died out millions of years ago. Neither were there any mammals in these interesting islands until man brought them there comparatively recently


Pacific & Atlantic

A FARM WORTH THOUSANDS OF DOLLARS

Quantities of silver foxes are now being raised annually in California. One of the principal farms is located at the base of Mt. Shasta. This region is excellent for the work


Herbert photo

COULD HOUSE WASHINGTON MONUMENT

The largest brick chimney in the world is that of the Anaconda Copper Mine at Anaconda, Montana. From the base to the top rim the huge cylinder measures 585 feet


International News Reel

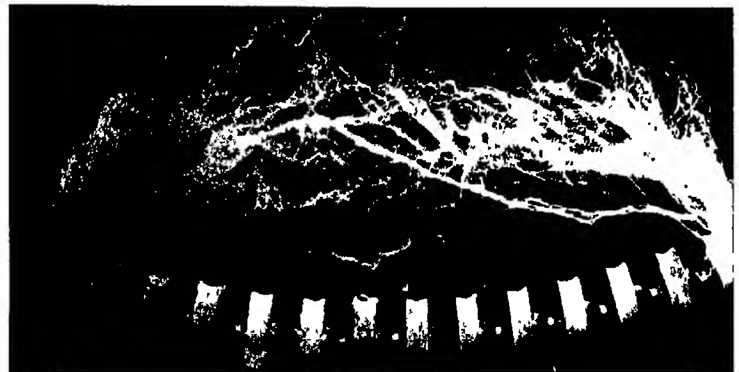
THE V-1 COMPLETES HER FIRST TRIAL TRIP

The largest submarine in the United States Navy starting out on its first trial trip. The giant undersea craft successfully negotiated a 204 foot dive and navigated for a full day in the vicinity of Block Island, to the complete satisfaction of the commanding officer and of the crew aboard


Wide World

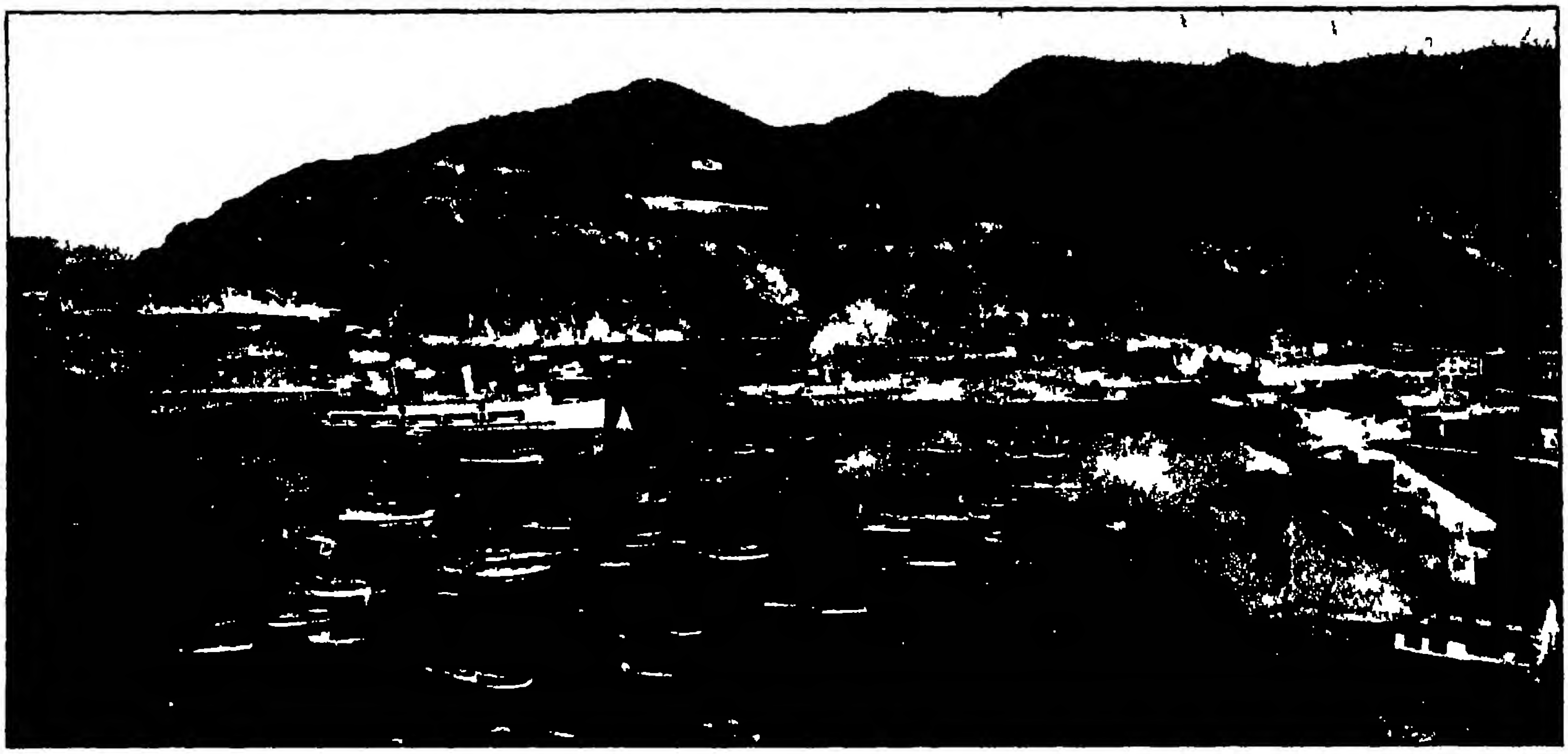
GOVERNMENT TESTING APPARATUS

Captain S. N. Petrenko of the Bureau of Standards operating his invention, a metal ring which measures a load up to a maximum of three tons


Wide World

ELECTRIC TRACERY OF A SPIDER'S WEB

Testing a chain of fourteen insulators at the laboratories of the General Electric Company. Under electric pressures of more than a million volts the sparks jump gaps several feet in length. Insulators that must function at 330,000 volts are tested at higher voltages



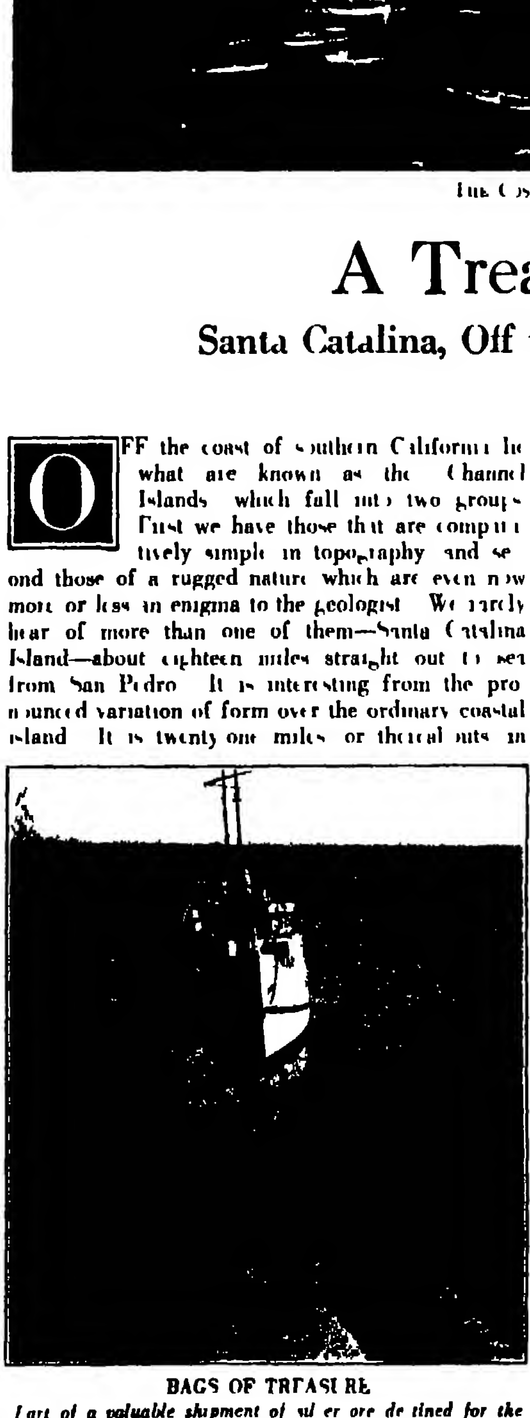
THE COSMOPOLITAN HARBOR OF AVALON, HAVEN OF ALL KINDS OF PLEASURE CRAFT

A Treasure Island in the Pacific

Santa Catalina, Off the Coast of California, Is a Veritable Island of Silver

By Herbert O. Warren

OFF the coast of southern California lie what are known as the Channel Islands, which fall into two groups. First we have those that are comparatively simple in topography, and second those of a rugged nature which are even now more or less an enigma to the geologist. We rarely hear of more than one of them—Santa Catalina Island—about eighteen miles straight out to sea from San Pedro. It is interesting from the pronounced variation of form over the ordinary coastal island. It is twenty-one miles or thereabouts in length and the width varies from three to seven miles except in one place where there is a narrow isthmus which is of so low an altitude that Nature seems to have started to make two islands instead of one but failed to complete the job.



BAGS OF TREASURE

Part of a valuable shipment of silver ore destined for the smelter at Shelby, California. A shipment is valued at approximately 150,000 dollars

Rugged mountain chains run through the island with spurs extending down to the coast, separated by deep canyons with precipitous sides which have their outlet in the sea. Some of the peaks are over two thousand feet high. There is little or no arable land and it would be difficult to find two hundred acres of tillable land in any spot on the island. The shores are pounded by the heavy surf of the Pacific. The island was once inhabited by Indians but owing to its ruggedness and the scarcity of water, it proved habitable only in a few places.

Originally an Unsuccessful Venture

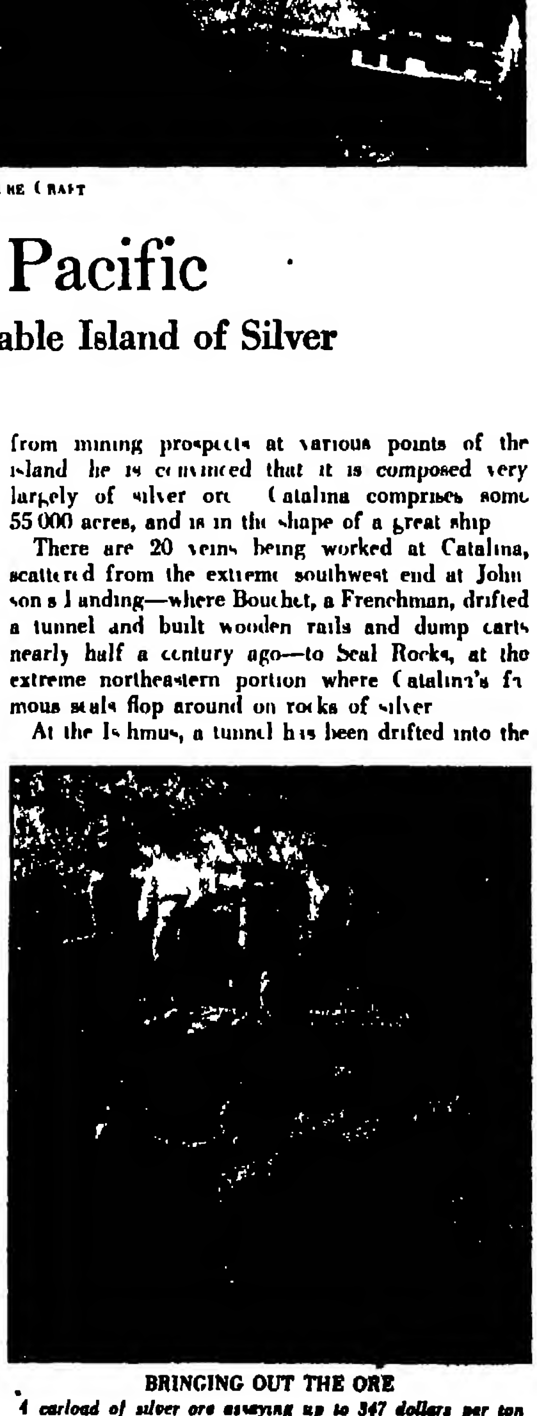
An English syndicate at one time bought the island for its mineral possibilities and tried to exploit them. However they were unsuccessful and in desperation they were glad to have the man, from whom they had purchased Catalina, take the island back again.

William Wrigley, Jr. Chicago capitalist, bought the island seven years ago for three million dollars and began spending a large sum every year in developing Catalina into a resort—and incidentally looking the island over a bit closer than did the Spanish explorers who, with their pirate ships many years ago, used to haunt the caves of Catalina while searching for places to secrete their ill gotten loot.

The new owner spent thousands of dollars building many miles of road into the interior fastnesses of the island, developing water power and making various other improvements. He rode on horse back over it day after day, covering practically every foot and examining rock and ledge formations. To-day, after having carefully checked assayer's reports from mining prospects at various points of the island he is convinced that it is composed very largely of silver ore. Catalina comprises some 55,000 acres, and is in the shape of a great ship.

There are 20 veins being worked at Catalina, scattered from the extreme southwest end at Johnson's Landing—where Bouchet, a Frenchman, drifted a tunnel and built wooden rails and dump carts nearly half a century ago—to Seal Rocks, at the extreme northeastern portion where Catalina's famous seals flop around on rocks of silver.

At the Isthmus, a tunnel has been drifted into the



BRINGING OUT THE ORE

A carload of silver ore assaying up to 347 dollars per ton that has just been brought to the surface from one of the shafts of the Black Jack mine

bank of the trail leading to the Chinese junk *Ning Po*, where hundreds of tourists pass daily to view the Oriental pirate ship. Some of the ore at this point assays as high as one hundred dollars a ton.

Fourth of July Harbor is the nearby cove on the north. Here another vein has been uncovered with similar valuable ore of silver and of lead. At Cherry Valley, the site of the Pasadena boy scout camp, is one of the first prospects explored by Wrigley. A tunnel was drifted for 410 feet into the west bank and a rich vein of silver and lead struck at 325 feet. This vein is about 25 feet in length and is heavy in valuable ore. East of Mt. Black Jack has been found a copper deposit running about 156 dollars per ton.

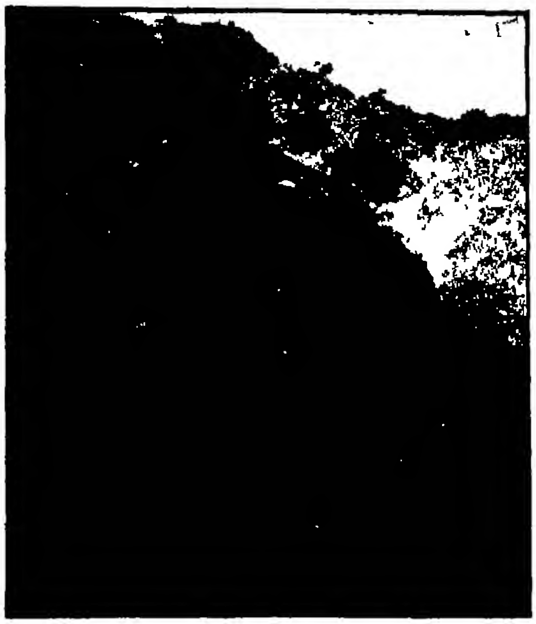
The mine which to date has been most extensively developed on Catalina Island is at the summit of Mt Black Jack, 2,100 feet elevation. Black Jack is the second highest mountain on the island, and about 20 miles from Avalon, the center of the summer resort colony.

A Vein 26 Feet Wide

Already 100,000 dollars in high grade ore has been shipped to northern smelters from this mine which now supplies the ore for the flotation mill. The main shaft is at a 475-foot depth. Assays of some ore from this mine run as high as 347 dollars per ton in silver, lead and zinc. The mine is electrically equipped, the power lines being brought over the mountains from Avalon. Roads had to be blazed through virgin undergrowth and over steep grades and blasted through solid rock to allow the ore to be brought on auto trucks from the mine to the boats, it being a down hill run of about three miles. All this was done in less than six months.

Four miles distant at White's Landing, the oldest Indian burying ground discovered by scientists on the Channel Islands—and from which priceless relics have been taken—is the flotation mill. Experts had claimed that it would take at least six months to install this plant. In 54 days the last bolt was in place and the big wheels began to grind out the silver treasure. Fresh water is unavailable for milling purposes at this point of the island and therefore salt water was tried.

From the mill at White's Landing, 350 tons of zinc concentrates were shipped directly to Belgium during the first week in February. This was the first European shipment of zinc from the Wrigley mines at Catalina. Belgium is greatly in need of zinc and in the future Catalina Island will be one



A VALUABLE PILE

This is the form of the mined silver ore when it is ready to be shipped to the smelter for refining

of that country's valuable sources of mineral supply.

Out on a pier which has been built for the shipping of the ore are piled sacks upon sacks of silver and lead concentrates, all neatly marked "Catalina" with red ochre—the same material used by the Indians centuries ago—which a workman found made a better stencil than modern paints. A ship, when ready to leave the pier with its consignment to the northern smelter at Shelby, near San Francisco, will have on board a cargo worth 150,000 dollars. When shipped via rail the concentrates will run 10,000 dollars per car. And the Spanish explorers sailed on—looking for a treasure isle!

With the discoveries being made at the Avalon end of the island, Wrigley is planning for a second flotation mill to be erected at Pebbly Beach. Here the great quarry which supplies crushed rock at the rate of 2,000 tons per day for the paving of Los Angeles city streets, has had to shift its operations because of running into a silver and lead vein so rich in minerals as to be unsuitable for the contractors. The rock proved too soft to hold up under heavy traffic. The big steam shovels which had been digging the rock were then transported further on and a crew of miners stepped into the excavation and took the places of the quarrymen.

Just around the corner of the island, near Seal Rocks, has been discovered the Renton Vein, the richest mineral strike on Catalina to date. Here a cross-cut reveals a vein 26 feet in width. The outcrop can be traced for nearly two miles over the mountain toward Silver Canyon. A tunnel has been drifted in 1,000 feet above sea level up a sheer cliff, with two other tunnels each 100 feet lower. It is estimated that this mine alone will keep another flotation plant in full operation.

Steam shovels and several crews of men are now at work constructing a road and laying power lines to this newest Catalina mine. The prospect of other mines does not stop at Renton Vein, however, for there are other possibilities on the Avalon side of the island. Even Mr Wrigley's palatial home atop Mt Ada has been discovered to be located directly over a silver vein. Another one has been found beneath the Catalina Radio Broadcasting Station, KFWO.

A Silver Golf Course

Three new mining prospects have been discovered just back of the island city of Avalon on the edge of the Catalina Country Club golf links. Offending rocks which ambitious players have been striking when "plowing up the ground" with their mashies, are found to assay high values.

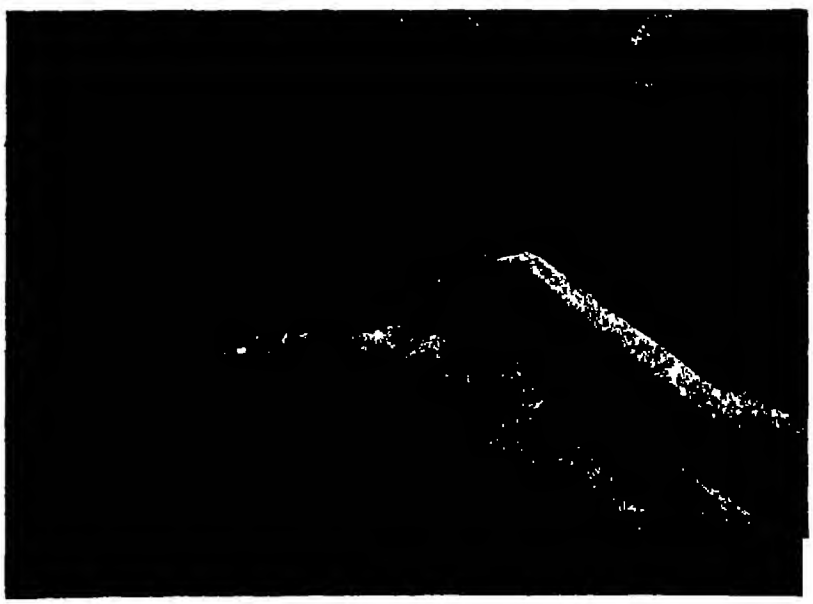
Wrigley, while on an inspection tour of the new Catalina golf links under course of construction adjoining the present greens, found three outcrops of veins where stakes had been driven for tees. Workmen are now sinking test shafts and assays of the surface ores are being made. The new mines will be known as the "Wrigley Three." Indications are that these mines will be the richest of any so far being developed in the island—according to assays made, which run for some ore as high as 70 dollars per ton in silver and 115 dollars in lead and zinc.

Some of the recent outstanding shipments and mining activity on the island are as follows: 150 tons of silver lead ore are being transported daily from the Renton Vein to the White's Landing flotation mill for reduction into mineral concentrates. The Black Jack mine is producing in the neighborhood of 100 tons daily which makes it necessary for the mill to run at full capacity on three shifts during 24 hours.

Early in March two shipments of silver lead concentrates of 16 tons each and worth approximately 15,000 dollars per shipment were made to the smelter, while 500 tons of zinc concentrates were shipped recently to Dunkirk, France.

LAYING THE ORE CAR TRACKS

This photograph shows how it has been necessary to fill in the land at the base of Mt Black Jack in order to allow for the building of the tracks for the dump cars



ONE OF THE SMALLER MINES

The topography of the mining territory of Catalina is clearly shown in this photograph. A group of miners are standing before the mouth of one of the mine shafts

THE CUT THROUGH THE MOUNTAIN DIVIDE
Battleship Colorado in Gaillard Cut near Cucaracha Slide, September 3, 1924

The Panama Canal Today

During the First Ten Years of Operation, the Earnings of the Canal, Excluding Interest, Exceeded Expenses by Over Thirty-three Million Dollars

By J Bernard Walker

To take a trip to the west coast "by the Canal" is one of the most popular excursions of the day, and justly so Not only is the Canal one of the most important links in the great trade routes of the world, but, judged from the spectacular side, it is one of the most majestic and inspiring works of construction ever achieved by the hand of man

It is difficult for the traveler who passes through the imposing flights of locks at Gatun and steams across the far spreading, artificial sea bearing the same name, and then moves cautiously but surely through that great gash through the mountain divide, known as Culebra Cut, and drops down through the locks to sea level on the Pacific—it is difficult, we say, to realize that it took much persuasion and long debate to make the country realize that it was possible and desirable to build this great waterway across the Isthmus of Panama

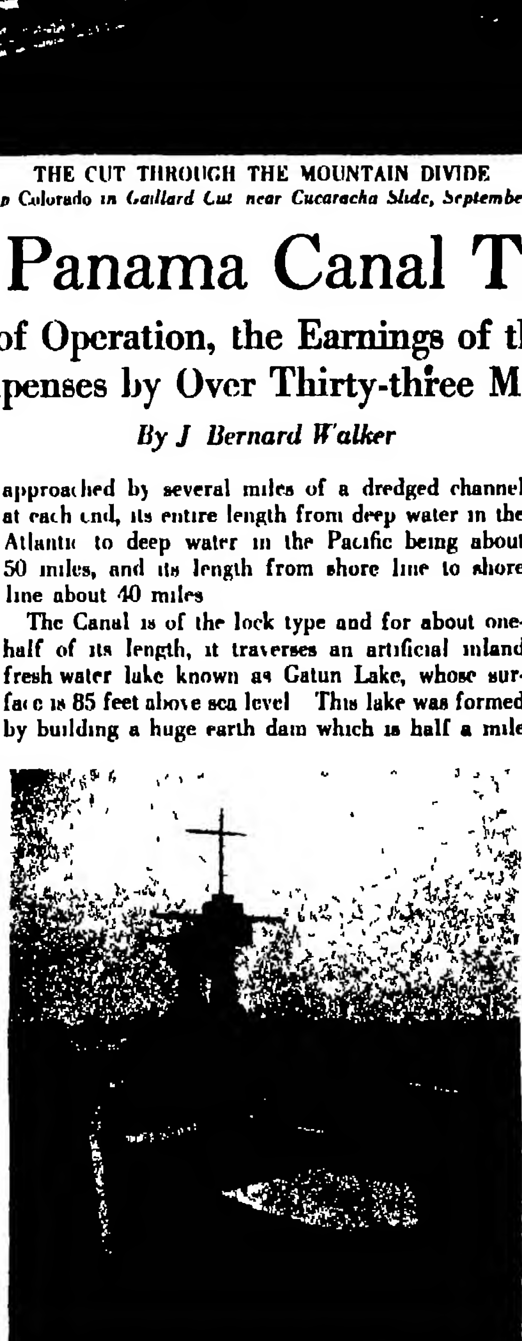
The Canal Is Half Lake

For several years, indeed, the good people of the United States were undecided as to whether they should cut a 40 mile canal at Panama or a 110-mile canal at Nicaragua We now know that the one scheme was as impracticable as the other has proved to be both practical, and, commercially, a brilliant success.

Before passing on to a consideration of the operation of the Canal during the first ten years of its existence, we will briefly refresh our minds as to the physical features of this truly wonderful engineering achievement

In the first place, let us remember that the Canal does not run east and west but because of the easterly and westerly lay of the Isthmus at this location, the Canal runs more nearly north and south It is approached by several miles of a dredged channel at each end, its entire length from deep water in the Atlantic to deep water in the Pacific being about 50 miles, and its length from shore line to shore line about 40 miles

The Canal is of the lock type and for about one-half of its length, it traverses an artificial inland fresh water lake known as Gatun Lake, whose surface is 85 feet above sea level This lake was formed by building a huge earth dam which is half a mile



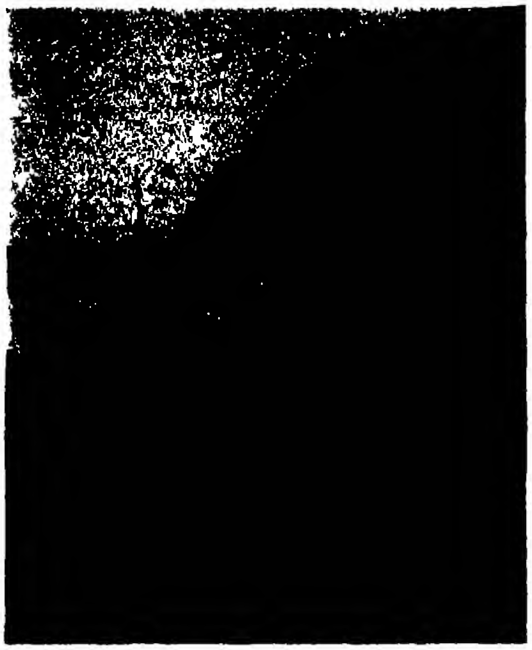
BATTLESHIP *MARYLAND* IN GATUN LOCKS
The ship is being towed, at two miles per hour, by powerful electric trolleys running on the dock walls She does not use her own power

in width at its base, across the valley of the Chagres River. Alongside this dam are the locks, three in number These, like all the locks throughout the Canal, are built of concrete They have a usable length of 1,000 feet and a width of 110 feet. At its westerly end, the lake is continued as a 300-foot bottom depth channel through the Gaillard Cut, nine miles in length At the westerly end of the Culebra Cut, a single flight of locks at Pedro Miguel serves to lower shipping to Miraflores Lake, an artificial body of water from which the vessels are lowered by a flight of two locks to sea level. They continue through a channel eight and a half miles in length and so out to deep water

An Emergency Dam Provided

The power for all the varied operations of the Canal, such as the opening and shutting of the gates, lighting of the channel and the provision of light and power at the terminals and shops at each end of the Canal, and so forth, is furnished by a hydro-electric plant at the Gatun Dam, where the head of water provided by the 85-foot elevation of Gatun Lake is utilized to furnish the electric energy required for the above operations.

The Chagres River is the source of supply of water for the Canal and its out-flow, which in times of flood is enormous, serves to maintain the elevation of the water in Gatun Lake at from 80 to 87 feet above sea-level, the height being determined by the balance between the rainfall and the loss of water through lockages, through operating the hydro-electric plant, and from the surface evaporation of the lake The surplus waters pass through a concrete spillway formed in the center of Gatun Dam, the outflow being controlled by gates on the crest of the dam. It should be mentioned that the depth



EN ROUTE ATLANTIC TO PACIFIC
The steamship Belgenland, of 35,390 tons displacement, passing through Gaillard Cut, December 12, 1924, on her world voyage. Largest merchant ship to transit the Canal

of water over the sills of the locks is forty feet in salt water and forty-one and one-third feet in fresh water.

The ships do not pass through the locks under their own power, since, through a misunderstanding of orders between the bridge and the engine room, there would be a continual risk of collision. To prevent this, the vessels are towed through the locks by electric locomotives running on tracks on the top of the lock walls. The speed is limited to two miles an hour.

To guard against an approaching vessel colliding with the gates, breaking them down and letting the waters of Gatun Lake run out to sea, various protective devices have been installed. First, there are massive fender chains stretched across the entrance, each weighing about 12 tons. These are placed on the upstream side of the locks. A further protection consists of double gates, which are provided at the entrance to all the locks and at the lower end of the upper lock in each flight.

If an unmanageable ship should break through the chains and smash down the gates, there is provided an emergency dam, which is really a massive turntable structure, which can be swung across the Canal entrance and by means of a series of steel plates, lowered upon it, would serve to close the entrance and prevent the waters of the lake from rushing down through the locks and wrecking them.

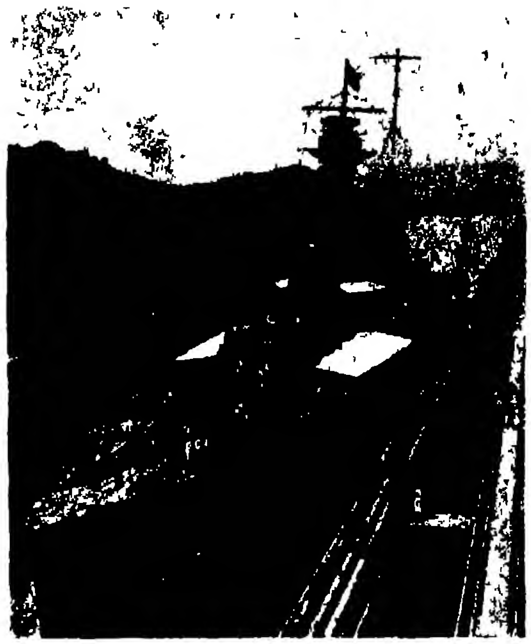
The first ten years of operation have fully justified the national policy which led the country to purchase the Canal from the French and complete it on a greatly enlarged scale. This is proved by the following facts, which are strictly official.

The vast sums of money invested on the Canal were spent partly for national defense and partly for commercial purposes. At the beginning of 1924, the investment charged to national defense was about $112,000,000 and that charged to commercial use was $275,000,000. Commercially considered, then, the Canal cost $275,000,000. The annual interest on this investment at three percent would be $8,250,000. The annual expenses do not include this interest charge, but do include an annual charge of $655,370.50 for amortization, et cetera, and a charge of $500,000 annually for depreciation.

Canal Now Showing a Profit

For the first four years of operation, the cost of the enormous slides in the Culebra Cut caused the revenues from tolls, and so forth, to fall below the expenses. In later years revenues have exceeded the cost of operation and maintenance. Thus, to June 30, 1924, operation cost about $70,000,000 but the revenues amounted to $100,000,000, of which over $97,000,000 was secured from Canal tolls. In addition, the extensive auxiliary plant, docks, coal and oil, storage, machine shops and so forth, cost for operation $100,000,000 as against business revenues from these sources of over $103,000,000. The excess of total earnings over expenses at the beginning of the fiscal year, July 1, 1924, stood at $33,241,425. This does not include the $8,250,000 annual interest on the original cost of the Canal above referred to. For the ten-year period this interest charge would now amount to $82,500,000, and subtracting the above $33,000,000 operating surplus, this charge would leave a deficit of $50,000,000 for the ten-year period.

The total earnings of the Panama Canal during the banner year which closed June 30, 1924, were $37,650,631 of which $24,289,603 was secured from tolls. The corresponding expense of operation and maintenance including depreciation but excluding, as mentioned above, the interest on the original cost



THE *HOOD* ENTERS MIRAFLORES LOCKS
World's largest warship. Length, 860 feet, beam 105 feet, 2½ inches, displacement, 45,200 tons. Less than 2½ feet clearance between the ship and the dock walls

of the Canal, was $20,441,059 leaving net revenues of $17,209,573. This, it should be noted, is more than double the annual interest figure and provides a surplus of about $9,000,000 to be applied to wipe out the deficit of previous years.

The rapid increase in traffic passing through the Canal during the few years preceding and including 1924 was due largely to the great discoveries of fruitful oil fields in California and the large number of tankers that conveyed the oil from the Pacific to the Atlantic. The Canal did less business during the fiscal year 1925 than during 1924 which was a record year. The number of vessels in transit that had to pay tolls declined from 5,230 to 4,673 and the gross revenues from tolls fell from $24,290,964 to $21,400,524. This was due entirely to the slump in California oil but with oil excluded from the list, the 1925 traffic shows a normal growth.

The Great Lakes are down two feet. Five inches are due to the Chicago Drainage Canal, nineteen inches to decreased rainfall. In our August issue we shall give the facts and suggest a remedy

IN THE CHANNEL OF THE ATLANTIC ENTRANCE
A general view of Cristobal terminus at the Atlantic end of the Panama Canal. Here are substantial docks and facilities for bunkering ships with coal and oil

ROUNDING A TURN AT PILA POINT
In spite of her great length and beam, the Hood was taken through the channels and locks without a hitch, reflecting high credit on the canal operating staff

Novel Devices for the Shop and the Home

A Department Devoted to Recently Invented Mechanical and Household Appliances

Conducted by Albert A. Hopkins

A pie plate for juicy pies

You Can Eat the Lower Crust

A NEW invention in pie pans is just out. It comprises the old pan with a deflecting wall of a circumferential construction that deflects the juices from the pie and prevents it from entering between the pan and the pie. Adjacent to the deflecting wall is a hollow part that catches the juices so deflected and prevents the juice from entering the oven of the stove.

Wicker seats for the upper deck of a double deck bus are a novelty and are specially woven to conform with the contour of the deck

Comfort on the Motor Bus

THE accompanying photos show how wicker seats for the upper deck of a double deck motor bus have been specially woven to conform with the contour of the deck. The wicker seats are built in three sections and are removable, facilitating the cleaning of the top deck. A windshield is also provided for the occupants of the front seats, as shown in the lower engraving.

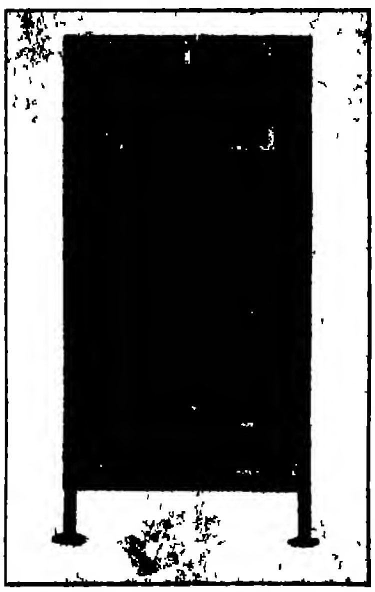
Novel Steam Line Control

THE accompanying photograph illustrates a new and interesting "twist" in the remote control of steam lines.

The mimic busses and nameplates shown on the black panel are of polished copper. The busses represent steam lines and the nameplates are engraved with the size of pipe to a particular boiler, size of pipe to a particular turbine unit or the location of valves.

The pushbutton stations are used only to close valves, each being in parallel with the closing buttons of another pushbutton station remote from the panel. The "open" control is located at the remote pushbutton station.

Each group of pushbuttons has three buttons. The topmost button controls the valve which feeds a high pressure steam line.



Panel for control of steam valves

Bump your car against the gate and it opens

Another type of wicker seats for the top of a bus

A zipper catcher's mitt

The Catcher Takes No Chances

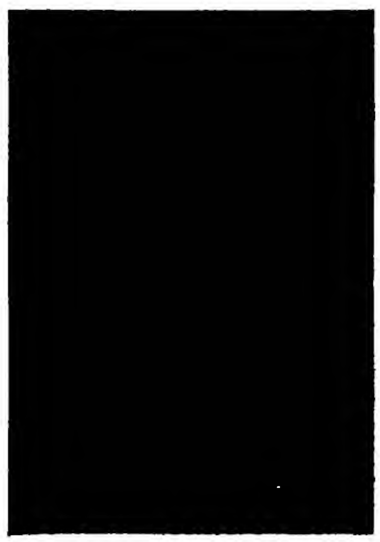
A NEW idea in baseball for the catcher's mitt is the so-called "zip-on" fastener that gives a secure feeling and keeps the mitt firm on the hand. The opening at the back on the back of the knuckles ventilates and makes the mitt more flexible.

Automobile Turnstile

WITH the auto turnstile, you simply drive the front wheels of your car at slow speed against the gate bumper and follow through as the gate begins to swing. The gate automatically completes a half circle turn stopping when in closed position behind you. The gate returns automatically by gravity.

Safety for the Bowler

TO prevent the bowler from slipping as he throws the heavy wooden ball down the alley, attachments of a material that will not slide on the floor have recently been invented to be worn on the shoes. They can quickly be slipped on or off, thus making it possible for the bowler to use his street shoes in the game and save the soles of these from the wear that results when no attachments are worn.



Anti-slip for the bowler

An electric trouble finder

Handy Testing Outfit

WITH this new testing outfit, the handy man around the home, or in the garage or private shop, has a means of diagnosing electrical trouble with very little difficulty This outfit has a special separable plug that fits any standard lamp socket or receptacle. It can be used on either alternating or direct current, enabling its user to discover and locate short circuits, grounded circuits and open circuits.

A Novel Pepper Mill

A LARGE dealer in household equipment brought back from England an ingenious novelty some months ago This is a pepper mill in the form of a miniature silver siphon. The whole peppers are inserted through an orifice in the bottom and a turn of the top is sufficient to grind the pepper

A deceptive siphon

A Nutcracker of Great Leverage

OUR engraving shows an extremely powerful nutcracker which is a recent importation from England. The construction is admirably shown.

A powerful nut-cracker

A Home Electric Dishwasher

OUR engraving illustrates an electric dishwasher which may be placed in a butler's pantry or in the kitchen. A similar unit can be supplied, built in to a sink When a load has accumulated or after every meal—hot water and washing powder are introduced into the machine and the lid closed A pressure of the switch starts the rotating dasher in action

The California Highway Commission keep the roadways smooth with a drag made of an old automobile frame. The tractor moving the drag to position

The drag is shown here ready for helping to smooth the highway

A built-in electric dishwasher relieves the housewife of drudgery

Avoid losing your license

Safeguarding the License

IN numerous localities a motorist's license is demanded on sight In the device shown a metal tube container holds the license Ignition keys are attached to it and the license is rolled within the tube It cannot work loose as the two sections of the container lock together

Automobile Air Cleaner

THIS device attaches to the intake of the carburetor and separates out the dust and grit and allows nothing but dustless pure air to enter the internal combustion chambers.

Cleaning the carbureter's air

Getting the Juice from Citrus Fruits

THIS device is adopted for obtaining the juice of grape-fruit, oranges and lemons. The divided fruit is pressed against a cutting head of the correct size—one being adopted for grape fruit, the second for oranges and the third for lemons. The juice passes through a strainer, thus separating the seeds.

A fruit juice extractor


A contented passenger

Keeps Baby on the Seat

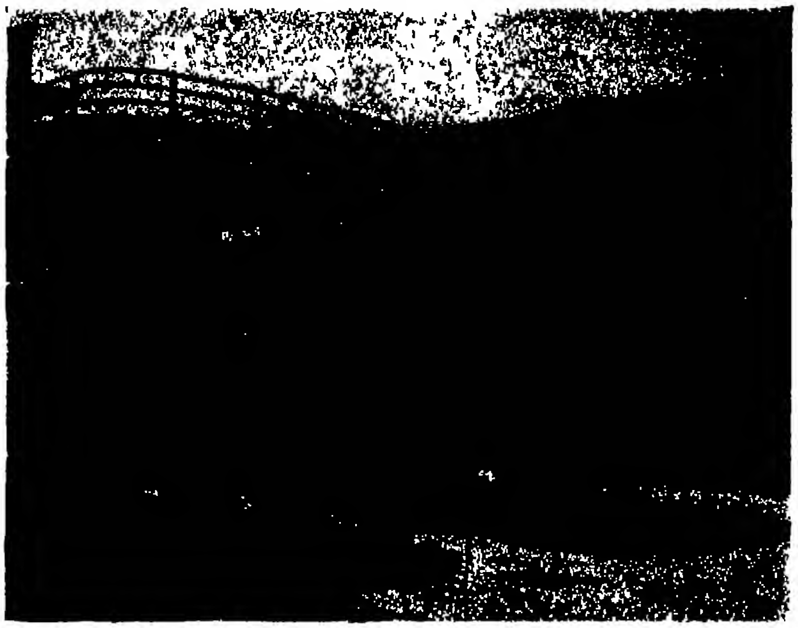
THE transportation of young children in automobiles is more or less of a problem and each year sees a new crop of inventions relative to carrying babies and small children comfortably and in safety. We illustrate herewith a seat for the baby that keeps the child safe and comfortable while riding in an automobile. This is a valuable adjunct to motoring. This seat can be placed in any car. The cushion is removed and the metal frame of the seat is placed beneath it. The back frame bends to fit the car. Baby sits on the cushion of the car and leans back. The cloth is placed between the child's legs and fastens to the frame on each side.

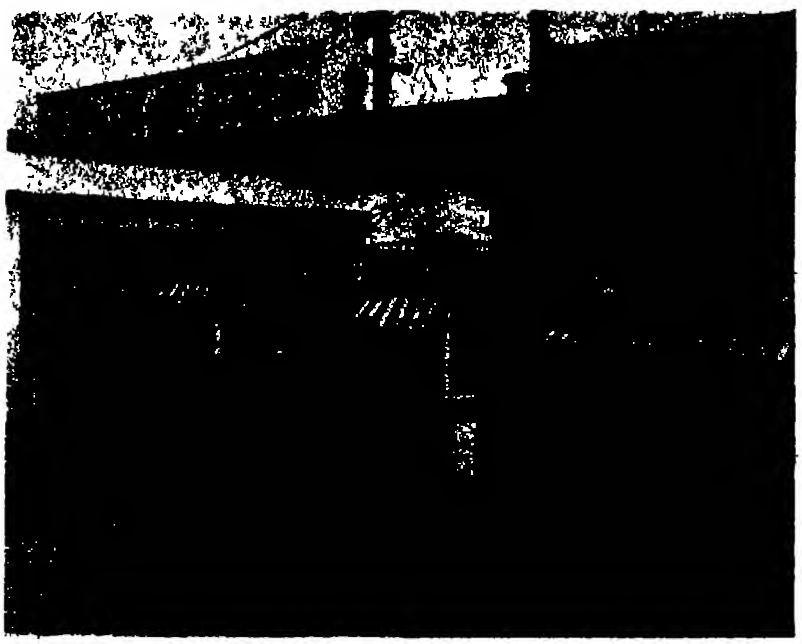

Details of the child's seat

Observation End Motor Parlor Cars

THE luxurious bus or "parlor car" is growing in popularity each season and now long trips can be taken with a maximum of comfort. The great advantage in cars of this kind is that a much better idea of the countryside can be gained than could be obtained from the windows of a train. People think nothing of taking such a journey in one of these luxurious parlor cars from say Boston to New York.

The accompanying photos show some of the interesting features of a parlor-car bus with an "observation" end. There is an artistic metal railing extending around the rear of the car. The center portion of the railing is hinged, permitting it to be swung open to give access to the spare wheel and tire carried on the back of the car. The spare wheel and tire are hidden from public view by the illuminated advertising sign when the center portion of the railing is closed. This sign is painted in red letters, and being perforated the rays of light from an electric bulb are thrown to the rear, producing an artistic effect at night. The railing along the back of the car also enables the driver to reach any part of the baggage rack arranged on the top. Special steps are attached to the railing to enable the driver or baggage man to quickly and easily reach the top of the railing and then by walking along the top of the railing, he can reach any part of the baggage rack. At the left rear of the bus there is a "stop" signal and tail light operated by a battery system of twelve volts. There is a special rear bumper made of two and one half inch pipe flattened at the ends and bolted to the rear of the car which both protects the metal railing and the rear of the bus. The gasoline filling spout is at the rear.


Observation end for motor parlor car showing tire carrier


A fleet of observation motor parlor cars ready for passengers

Escalators Displacing Elevators

THE new escalators at Trafalgar Square Station, London, on the Baker Street and Waterloo Railway, have now been opened and the elevators closed. The space occupied by the latter will now be devoted to new and larger ticket offices which will be able to deal with 8,000,000 passengers a year instead of 4,000,000 as at present.

Novel Stairway Noses

THE edges of steps of concrete stairways should be provided with nose pieces particularly if material of any kind is to be moved either up or down over them. The *Coal Age* shows how scrap material can be used for this purpose. The nose of each step is protected by a piece of pipe cast into the concrete and extending into the retaining or wing wall upon either side.

Street Cleaning in Berlin

WE illustrate a new motor watering cart which combines also other utilities such as a snow-plow, sweeping machine and fire extinguisher. Our engraving shows the motor in use as a watering cart. The snow plow and the sweeping appliances can be seen at the front of the machine.


A "four-in-one" street cleaner and washer used in Berlin

Teaching Firemen to Handle High Pressure Valves

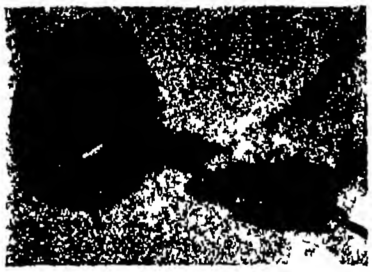
THE San Francisco Fire Department has installed one of the high pressure valves used in the city water lines for fire protection on a four wheel truck and has built a portable platform for use in instructing firemen in the proper method of opening and closing the valve. The firemen stand on the elevated platform when opening the valve, it being necessary to make one hundred and seventy-six turns with the large hand wheel. This usually requires about five minutes. The pipes and valves actually in use in the high pressure fire protection system in San Francisco, are at times under pressure as high as three hundred pounds.


A demonstration water valve

Baby Carriage with Parcel Carrier

WHEN taking the baby for a ride, the modern mother need not load the baby up with the parcels that she purchases along the way. The package carrier on the back of this carriage takes care of all this. Besides being one of the lightest baby carriers made, this "cart" may be folded up and taken along on a trip in the car.


Double-duty for the baby carriage



Portable electric heater

You Can Pick Up this Heater

THIS handy electric heater is practical for many uses, such as for drying hair, warming cold beds and even as an aid to starting the automobile engine. When used as a small room-heater, it is placed upon its three legs.

An Automatic Train Stop

THE New York Central Railroad has shown commendable enterprise in the speed with which it is equipping its lines with automatic train control. Up to a few months ago 1,165 locomotives, operative over

Blow torch used as soldering iron

871 miles of line and 2,398 miles of track had been provided with the device. Additional mileage is being added constantly. The mechanism of the automatic train stop consists of a device fastened alongside the track, controlled by block signals. The locomotive carries another part, called the "receiver." When the receivers on a passing locomotive approach a prohibited area, the brakes of the locomotive are applied automatically and the engine must come to a full stop before they can be released.

Three-in-One Footwear

FOOT toboggans, combined with snow shoes and skis for the pleasure of children, provide a new winter sport. They have recently been invented and are now being manufactured in Missouri. Coasting on these sleds for the feet provides new snow thrills, it is said.

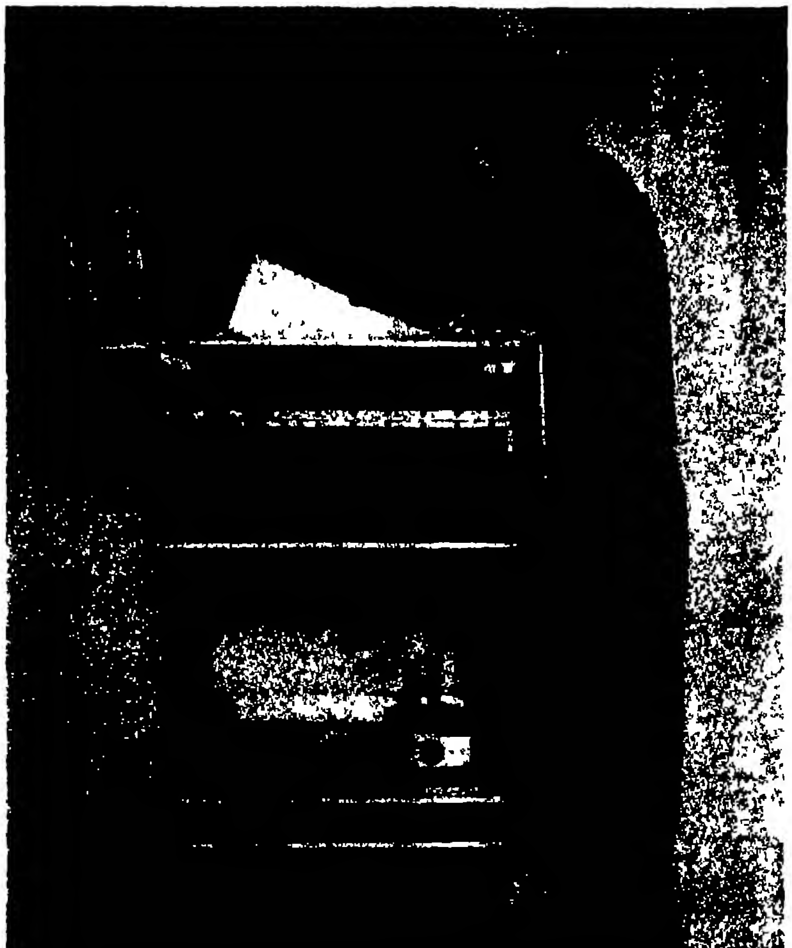
A new thrill for the winter

The automatic train stop is a reality on the New York Central Railroad

Soldering Iron and Torch

HERE is one of the handiest tools that a person can have around the house. It is a combination soldering iron and blow torch. No pump or pressure system is needed to operate it. Just fill the hollow handle of the iron with gasoline, light it, and in less than three minutes the iron is ready for use. To use it as a soldering iron, simply screw in the copper tip and proceed.

The controlling and recording mechanism



A speedy photographic duplicator

Can also be used for fire purposes

This Hose Won't Kink

HERE is a hose reel that will not kink the hose. It works like the fire-hose reels you see in public buildings. The axis of the reel is hollow, and the short length of hose that attaches it to the water system is connected to a swiveling joint at one end of this axis. Seize the nozzle and run out

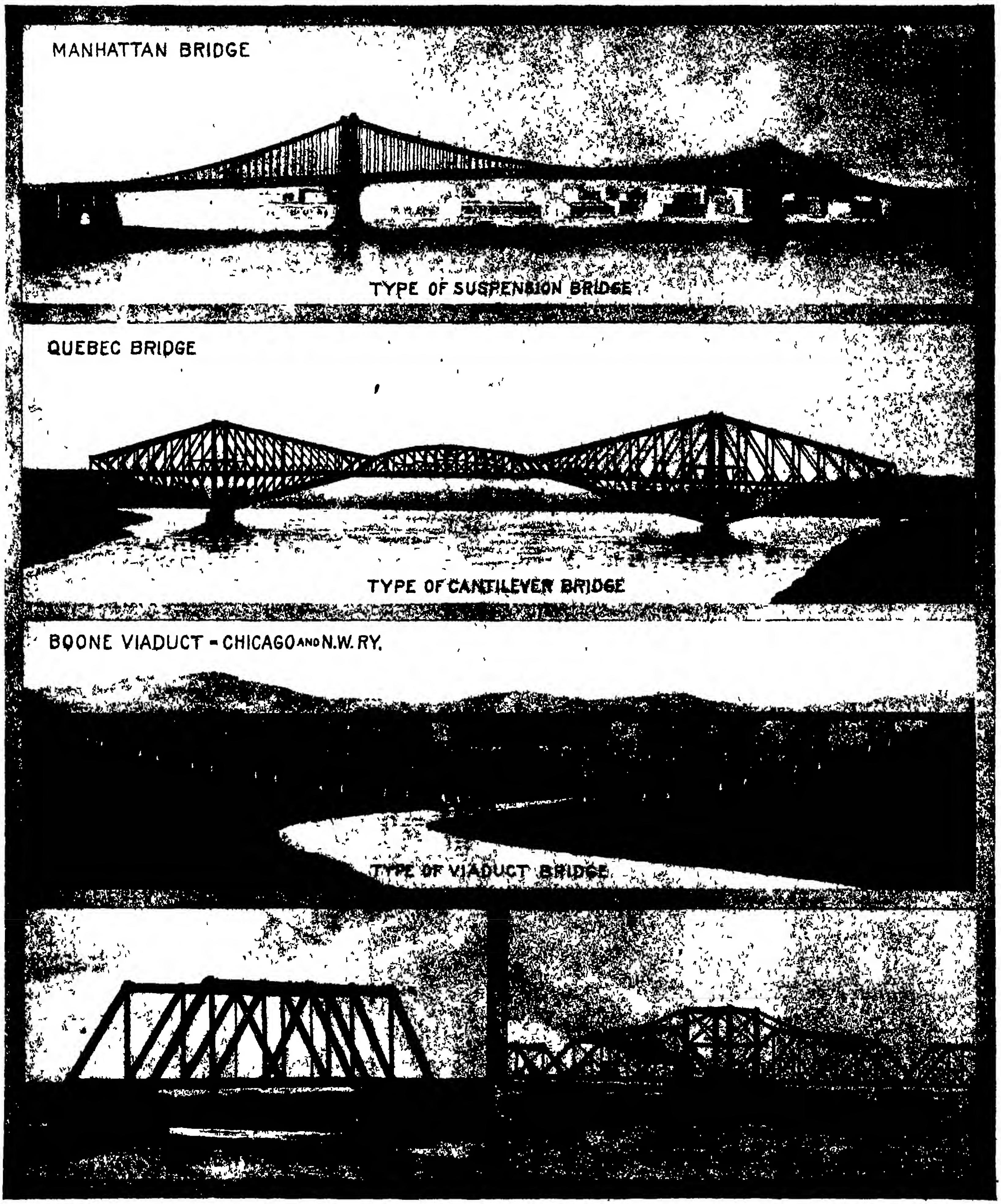
Gasoline blow torch and soldering iron

the hose as fast as you want to. The equipment shown on this page is primarily for use on the lawn. In winter time it can be kept in the cellar, permanently attached to a water tap. There it provides instant household fire protection.

A Rapid Photographic Printer

NEWS photo services and photographers requiring a large number of proofs will find this machine extremely speedy and economical. An automatic counter and timer serves to turn on and off the electric light and also keep track of the number of prints exposed. The use of a powerful light would soon destroy the film if it were not protected from undue heat by a special cooling device. The warm air is forced from the printing chamber and cool air is forced into it. The prints all have uniform exposure by means of springs which insure an even contact. The cooling arrangement already referred to is the most novel feature of the device, which was invented by Commodore Matthew J. Steffins of Chicago. The small illustration shows the timing device and the counter which takes care of the number of prints.

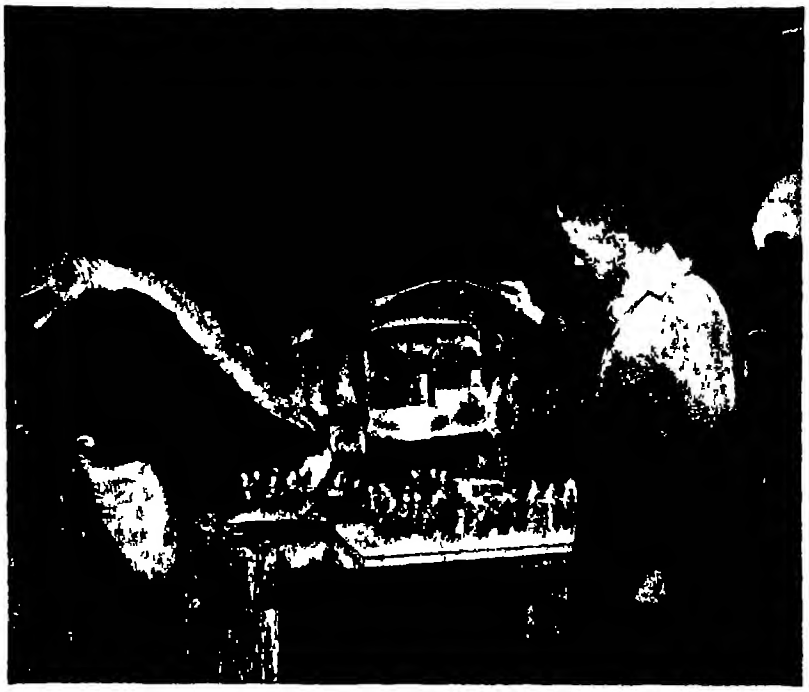
Toboggan, snow shoe and ski



Types of Modern Bridges

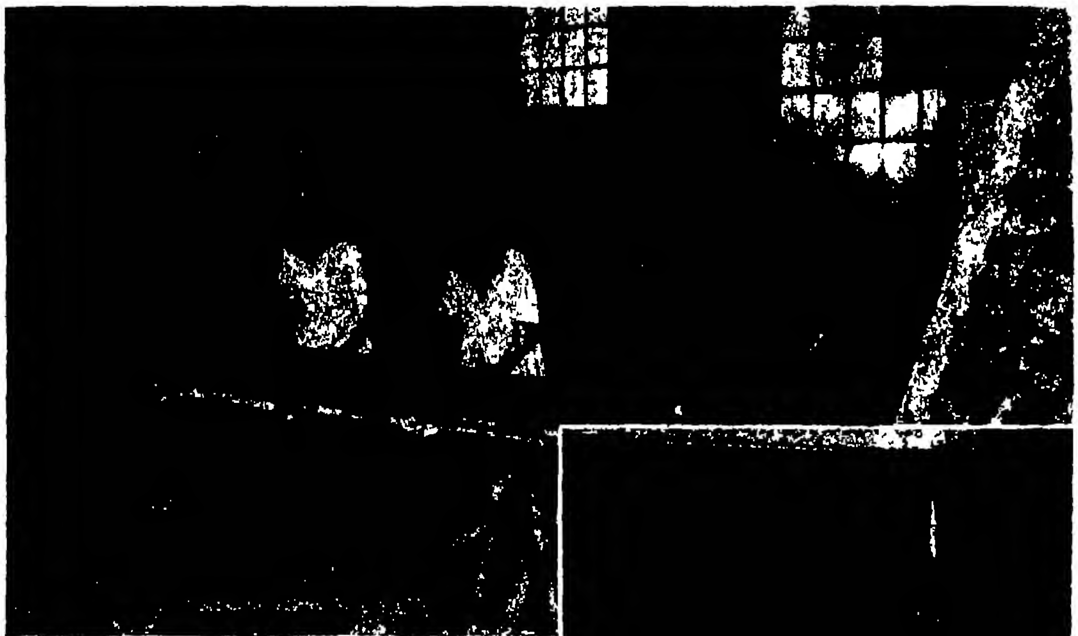
ADJUSTING THE EYES OF THE CAMEL

Papier mache animals, to be lifelike require mechanical "insides" which are here shown, beside the motor Foote reduction gears actuate the mechanism for turning the eyes ears and operating the tongue of the camel



THE "INSIDES" OF A SMALL DINOSAUR

This miniature mechanical dinosaur which is only eight feet long was built for display for advertising Sir Arthur Conan Doyle's "The Lost World" Its body, head, eyes and tongue move in a natural and life-like manner

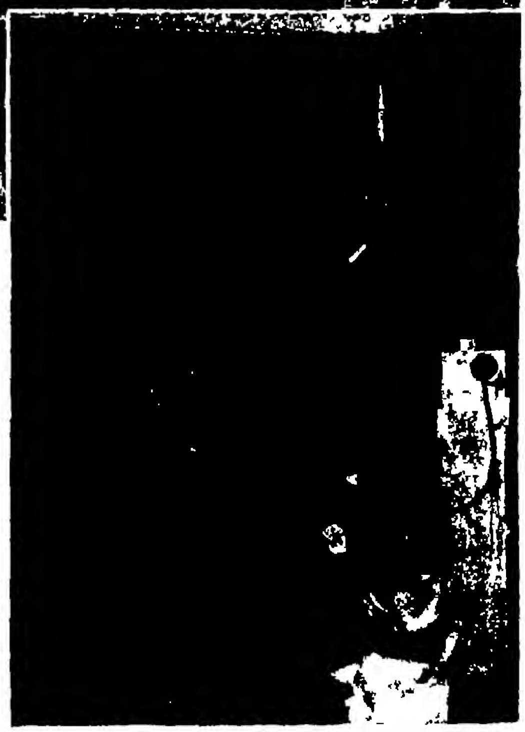


MAKING THE PAPER FIGURES

Girls are all deftly "laying in" wet paper As many as fifteen superimposed layers of "bogus" paper are laid in large molds • After the paper is thoroughly dried, it is trimmed where necessary and sandpapered smooth just like wood Papier mache can be fastened with nails and screws

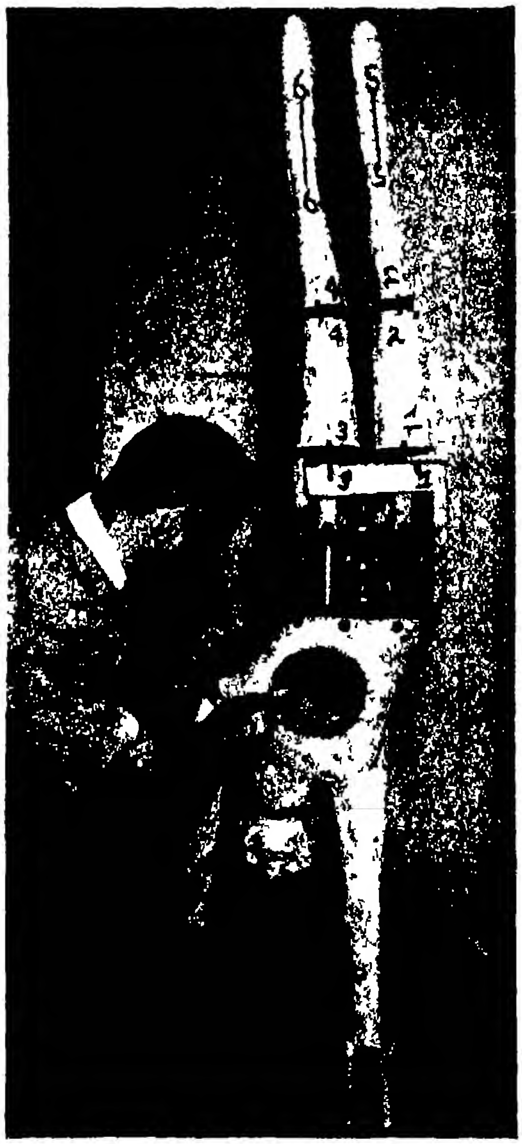
Paper Sculpture

The production of figures and animals in papier mache is not new. The manufacture of such objects has been going on for many years. Now, however, with the aid of clever motors and reduction gears, it is possible to give slow and accurate motion to various animals. A huge mammoth is now being constructed in the studio of Messrs. Messmore and Damon, New York City. In this studio are buffaloes, tigers, lions, giraffes and other animals. A switch is thrown and the animals begin to move at once giving a very realistic and jungle-like effect.



PAINTING THE BRONTOSAURUS

This little relic of bygone days is forty seven feet in length and nine and one-half feet high and is moved with the aid of ten motors The eyes, head, neck, ears and stomach move He almost looks as though he were going to take a drink from the pail of paint



ADJUSTING THE ACROBATIC CLOWN

The papier mache body is filled with machinery which sways the body and contorts the legs The clown's body works in a circular motion and when the entire display is fully assembled there is a little mechanical dog in front of the clown that wags its tail

The Scientific American Digest

Newest Developments in Science, Industry and Engineering

Conducted by Albert G. Ingalls

Astrophysicist Travels 30,000 Miles in Interests of Long-Range Weather Forecasting Research

To find the one spot in the eastern half of the world where the sun's radiation can best be measured, Dr Charles G Abbot, director of the National Geographic Society's Solar Radiation Expedition in cooperation with the Smithsonian Institution, has just completed a journey of six months in which he traveled 30 000 miles. His investigations took him to the edge of the Sahara in Algeria, to the sandy wastes stretching back from the Nile to the Sinai peninsula where Moses received the commandments from God, to the home of the wild warrior tribes of the hills of Baluchistan, and at last to the land of the Hottentots of Southwest Africa. There, on an isolated precipitous peak he found his goal, and there caves are now being fitted out to receive two American observers and their delicate instruments for measuring the sun's radiation. One more essential step in the attempt to make possible weather forecasting weeks and even months ahead has thus been taken.

For long range weather forecasting is the ultimate probable result of the Smithsonian studies of the sun of which Dr Abbot's expedition for the National Geographic Expedition is a part. To explain the expedition's place in these studies will require an understanding of their present status.

For more than 30 years the Smithsonian Institution has been measuring the sun's light and heat. By 1903 the Institution's scientists began to think that solar radiation varied from day to day and from year to year. They tested this conclusion by measurements at stations ranging from sea level to Mt Whitney, three miles high and from California to the Deserts of Sahara and Chile over many years of study before they allowed themselves to fully believe it. By 1925 conclusive proof had been developed that this variation influenced the earth's weather. The manner in which this influence is brought to bear however is very complex and has not yet been fully unraveled. But it seems demonstrated that a variation as small as one half of one per cent is sufficient to produce really noticeable changes in weather. For this reason it is vital that the measurements of solar radiation be accurate to the highest degree. To increase this accuracy is the main reason for the establishment of a new station in the Eastern Hemisphere. Daily measurements from this station will check those made at the two stations in California and Chile, which the Smithsonian already has.

The ideal spot for measuring solar radiation would be at the top of the earth's atmosphere. In choosing a site for the new station therefore Dr Abbot had to seek a spot where conditions approximated as nearly as possible those at the top of the earth's atmosphere. First the air had to be as pure as possible free from dust and smoke, it had to be dry because even a small amount of water vapor absorbs great quantities of solar radiation, it had to be rare, which condition could only be satisfied by choosing a high altitude, it had to be uniform and unchanging.

But these physical conditions were not all. The site had to be easy of access so that complicated outfits and supplies could reach the station, and under stable enlightened governments, safe from theft and massacre and where supplies and society could be found.

To meet all these difficult conditions was no simple task. Dr Abbot's first objective was the summit of Djebel Mekter, a peak 7,000 feet high, near the military post of Ain Sefra in French Algeria. Dr Abbot climbed the peak, but he was only moderately favorably impressed with the sky conditions.

Egypt, Dr Abbot's next stop, boasts of its cloudlessness, but the desert lacks easily accessible peaks necessary to getting above the haze and sandstorms. Dr Abbot learned of a mountain on the border of the Sudan where no rain ever falls, but to reach it required a 200-mile journey over sand from the nearest water. Mount Sinai, where Moses received the Law also had to be crossed off the list of possibilities because of the difficulty of access the bleakness of its winters and several other drawbacks.

P & A Photo

Dr. Charles G Abbot and his invention, the silver-disk pyrheliometer for measuring the heat of the sun's rays, which is being used by the Smithsonian Institution in connection with Dr. Abbot's new method of weather prediction

Dr Abbot left northern Africa and Asia Minor little cheered by the sites they offered. His next objective was the region about Quetta in British Baluchistan. The first condition to be met in considering a site in this stamping ground of the warlike hill tribes was the safety of the observers. Formerly the savage hill men used to pour out on the plains of Delhi on raiding expeditions. The British have established posts in Baluchistan and easterly to put an end to this but the hill men are no less worth watching for that. In going about in the neighborhood it is the regulation that each auto shall contain a loaded rifle and two men able to use it, besides the chauffeur. If ladies are to be of the party, two days' notice to the garrisons are required.

In such country as this Dr Abbot inspected sites. He finally picked on Khojak Peak, 70 miles northwest of Quetta and only ten miles from the Afghan border. This peak is 7,500 feet high, and but half a mile from Khojak Pass.

The authorities, while they regarded the Khojak as one of the safest regions in their jurisdiction, imposed the conditions that the American observers, if they established themselves there, must live at the garrison post of Shelabagh three miles east, that a couple of enlisted natives must be continually at the observatory on the peak, and that a third must always ride on the auto to and fro. Against these disadvantages Khojak possessed the attraction of superb sky conditions. "Neither on Mount Whitney in California," said Dr. Abbot, "nor on Mount Montezuma in Chile, have I ever seen quite so pure a sky as I saw there."

Reserving decision on the Baluchistan site, Dr Abbot set out to investigate his last possibility — Southwest Africa. Pushing through the big cities of the Union of South Africa he reached the upland country which has been given to the Hottentots as a reservation. He thus records his impressions of the heavens at night in this area:

"It was a glorious sky. At one time 16 of the 21 brightest stars of the whole heavens were visible. So exceedingly clear was the atmosphere that the great stars went blazing down to the very horizon and were blotted out, one by one, by the hills 30 miles away, with lightning-like suddeness. Before such an inspiring sight sleep came but fitfully." Dr Abbot added that no one remembered any rain for ten months so that he could not but decide that if a site could be found, this was the ideal spot for his observatory.

The following day by auto and on foot, guided by a Hottentot, Dr. Abbot climbed Mount Brukkaros. "It is a strange mountain" he says of it. "Lying about 20 miles to the west of the railroad and 200 miles south of Windhoek, capital of Southwest Africa, Mt. Brukkaros sticks out as the only peak of consequence in a circle of at least 50 miles diameter. It is inaccessible on all sides excepting by the dry bed of a stream approaching a gradual ascent of about three miles from the south. The mountain is 5,200 feet above sea level and quite 2,000 feet above the plateau. Only four or five miles in its greatest length and with no neighboring peaks for many miles, its isolation and abruptness are really uncanny. The summit is like a cup with a flat bottom about half a mile in diameter and a steep rim 1 000 feet high."

Hours of exhausting scrambling finally revealed a suitable site for the tunnel 35 feet deep which will provide for the installation of the bolometer, an electrical thermometer, sensitive to a millionth of a degree, which therefore requires very constant temperature. The exposure was suitable to permit the sun's rays to be reflected in the cave within an hour of sunrise. Dr Abbot therefore settled on this site, and the chief of the Department of Works of Southwest Africa is now engaged in getting it into shape.

Before finding the observatory site, Dr Abbot had come upon a natural cave suitable for a dwelling for the observers. This required only moderate enlargement and the building of a front wall and partitions to make it the most satisfactory home possible in such a place. Warm in winter, the heating problem will be solved, and with a porch awning for summer, it will be the only cool place except the observatory on the mountain.

Such will be the home and the working quarters of two American observers for the next three years at least. The men are scarcely to be envied even by the most optimistic. They will be exiled on a barren crater in the wilderness, seven miles from even Hottentot neighbors and 60 miles from a fair-sized town. To cover even that seven miles they will have to scramble down a 60-foot precipice and then pick their way three miles over a stream bed to their automobile. They will have to haul their supplies over this route and derrick them up the precipice. There is no water in the cup itself, so that until the contemplated reservoir catches enough from the meagre rainfall they will have to haul this from the foot of the precipice.

What are the compensations for this isolation and loneliness? The phonograph and the radio, of course, which will permit them to listen in on Cape Town and Johannesburg, books and games to fill their leisure hours, hunting of sorts,—springbucks, gemsbucks, koodoos and even leopards. But most important of all, a work which is absorbing in time and energy and which promises results for which any man might be proud to sacrifice himself. *For it is difficult to conceive of any scientific accomplishment whose results would be more immediate to every human being than that of the perfecting of long range weather forecasting.* It would remove much of the element of risk in the farmer's economic life. It would mean safety to the sailor and to the airman, it would mean the elimination of waste and loss to the business man and its economic significance would be incalculable.

The Smithsonian Institution, of course, does not propose to enter the field of weather forecasting. It is an institution for the learning of new facts for the increase of knowledge among men. What it is now seeking to do is to unravel the facts concerning the sun and its influence on weather.

When it has done this it will leave their application to other agencies.

The Smithsonian Astrophysical Observatory has concrete proof that it is on the right track. Since 1918, for instance, the Weather Bureau of Argentina has been making weekly forecasts on the solar constant values received from the Smithsonian observatory in Chile These forecasts have proved so valuable that the government is

Experiments with artificial lightning. Lightning either strikes a rod or strikes the ground at least four times the length of the rod away

able to sell them to business men and farmers.

From the point of view of safety, accessibility and sky conditions, Mt Brukkaros was the most favorable spot found by Dr Abbot for the observatory to be established with National Geographic Society funds He expects to have good weather for observing every day throughout ten months of the year and three quarters of the time in the remaining two months—the so-called rainy season. Annual rainfall averages about 3 inches. Although the new station is not so high as the one in Chile, the dryness and clearness of the air are very extraordinary

Having picked his spot, Dr Abbot had to obtain a vote of the Hottentot tribe to permit him to locate there. This he got easily In addition, the government of Southwest Africa proved cordial to the project and has assigned Mr A Dryden, Public Works Inspector, to build the observatory at cost Free importation of the outfit is also guaranteed

Meanwhile the outfit in America has been made ready The two observers have been picked They are Mr W H Hoover and Mr F A Greeley, both of whom have spent years under Dr Abbot s direction on other observatories of the Smithsonian Institution They will leave for Africa in July and it is hoped that observations will begin in September, and that daily reports will begin to be wired to Washington about six months later

* * *

Protecting Oil Tanks From Lightning

THE recent oil fire in California, which resulted in the death of two men and the destruction of more than $10,000,000 in oil and property, was attributed to lightning. The lightning hazard is well known to the oil industry and studies of protection methods have been made.

Oil storage tanks are necessarily so large that reinforced concrete tanks, rather than those of metal, must usually be used These concrete reservoirs are frequently 500 feet in diameter and sometimes in oval form as large as 600 by 1,200 feet and 30 feet deep As many as 25 or more such tanks sometimes make up a "tank farm" The tops are of wood, often covered with felt as a protection from the heat of the sun and the consequent evaporation.

Very frequently, especially with certain types of oil, the space between the surface of the oil and the top of the tank becomes filled with an explosive mixture of air and oil vapors. In general, no lightning protection is used.

F W Peek, Jr consulting engineer of the General Electric Company at Pittsfield, Mass., speaking at the annual meeting of the American Petroleum Institute in Los Angeles last January, described experiments which had been made in the Pittsfield laboratory with artificial lightning and miniature oil tanks, and told how protection from direct hits by lightning can be secured The following written from notes made during Mr Peek s address, are of interest in view of the recent oil fires.

"In considering oil tanks, two cases must be kept in mind—the tank containing explosive mixtures and the tank free from such gases

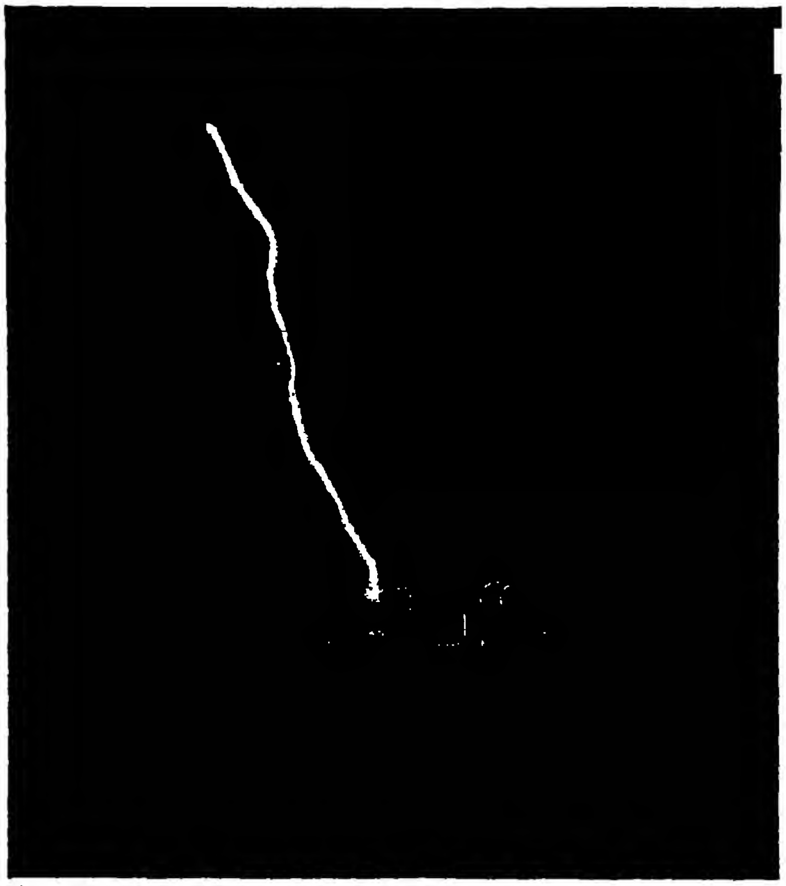
"Where there are explosive mixtures, the protection problem is exceedingly difficult Just as a considerable voltage may appear on electrical transmission lines a mile or more from the lightning discharge, because of 'wireless' or induction effect so may sparks be caused by voltages induced in metal parts of the tank, even though the tank is not struck directly by the lightning A spark at 500 volts, caused by a lightning stroke several miles away could ignite the mixture and cause great damage

"If a tank were made completely of insulating material there could be no spark but there are always pipes, nails conducting strips, and so on more or less isolated Grounded wires strung over the tank, as in the case of a protected transmission line would reduce the voltages A grounded two inch net cage would reduce the voltages to about one tenth The hazard would be reduced but it would only mean that the storm would have to come closer to cause the little spark The only safe method where there is explosive gas is a complete metal tank inside of which no sparks can occur Even then, however there is danger when projections extend from the surface

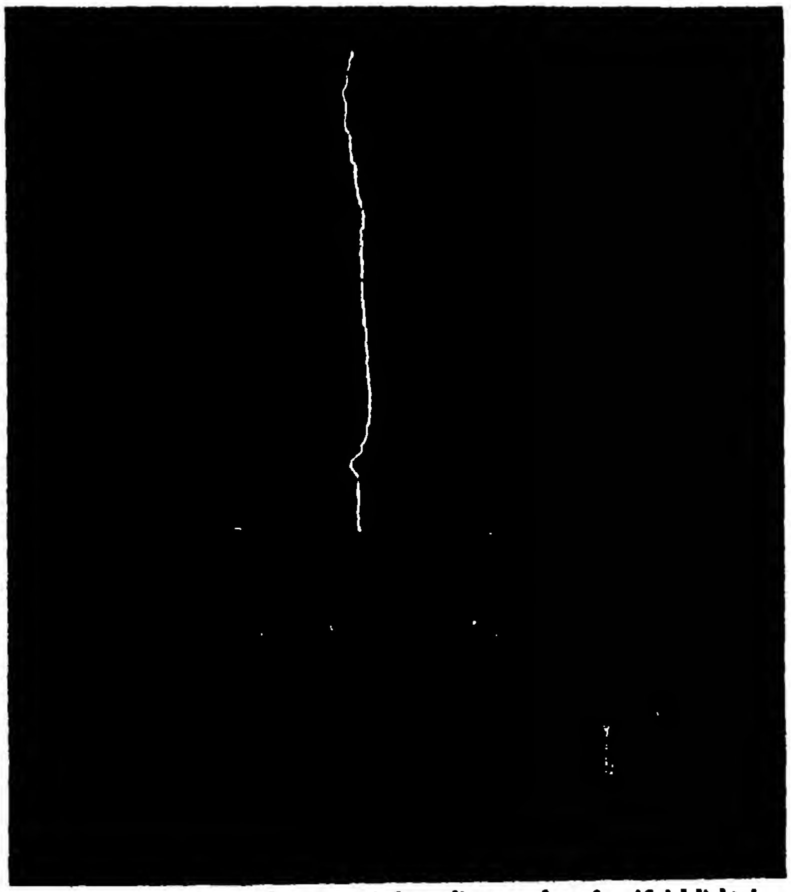
"Where explosive mixtures of gases can be kept from the tank, the chance of induced voltages causing trouble is small Direct hits however could set the oil-soaked roof on fire There are a number of principles discovered in the Pittsfield laboratory, that can be applied to prevent the tank from being struck. It has been found for instance that lightning never strikes the ground nearer a conducting rod than four times its height If the lightning does not strike the rod, then it hits the ground some distance away A number of rods properly placed about the tank would either take the hits or cause the lightning to strike the ground some distance away Grounded wires strung over the tank, a grounded metal net or metal roof afford protection against direct hits A tank made completely of metal is ideal here also

"The researches, which showed that a man standing has 15 times the chance of being struck by lightning that a man flat on the ground has showed that a storm discharging over a tank farm is likely to strike it They also showed that it is the edge of a small tank which will always be struck while the very large tanks may be hit anywhere

The investigations also showed that explosive gases may be set off by sparks produced by means other than lightning as for instance static sparks produced by friction"



Artificial lightning makes a direct hit on an unprotected miniature oil tank in a demonstration of lightning protective measures



A wire strung over a tank protects it from direct strokes of artificial lightning

This reflecting telescope cost less than ten dollars to make

Another Amateur's Telescope

THE description of a long focus Herschelian type, reflecting telescope has been received from Mr A B Hayden, its maker an attorney and an enthusiastic amateur telescope maker who lives in Manchester, New Hampshire A photograph of the telescope is reproduced above

The concave mirror has an aperture of 5¼ inches and a focal length of 112½ inches. The mounting is of the alt-azimuth type and has slow motion handles in both altitude and azimuth. The mirror is mounted in an open framework, instead of a closed tube, and is protected from cross lights and reflections by a hood, shown at the rear or lower end of the telescope. The eyepiece is similarly protected. It is mounted a few degrees outside of the optical axis so that the observer's head does not intercept the light entering the telescope.

Because of the great focal length as compared with the aperture there is no perceptible distortion of the image. The Herschelian type of mounting dispenses with the use of prisms or diagonal mirror, although it has other drawbacks.

The total cost of the telescope, exclusive of the finder, was less than ten dollars, according to Mr. Hayden, who is now working on a twelve-inch Cassegrainian type of telescope with 52-inch focal length. This instrument will have a fixed equatorial mounting, with a shelter, which will make it more expensive.

• • •

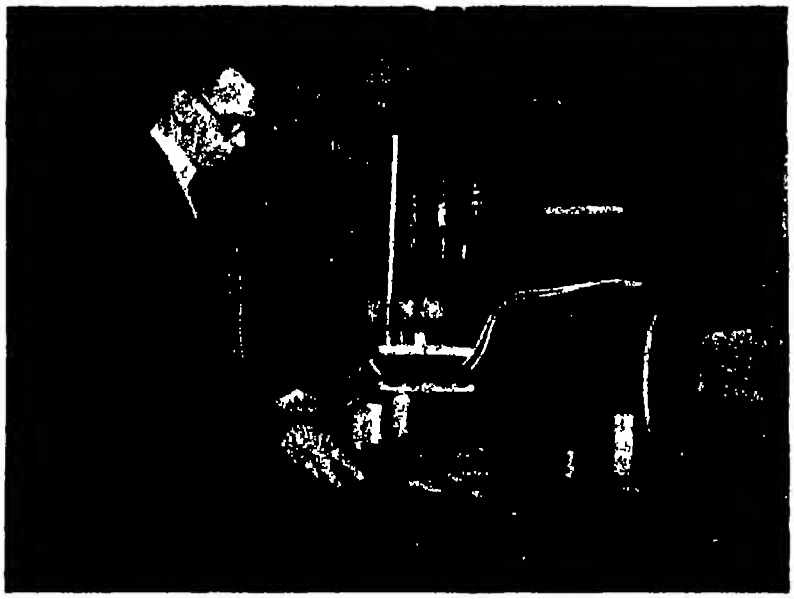
Whistling Backwards, an Example of Railroad Conservatism

WHERE should a locomotive whistle be placed? Why are the whistles of locomotives customarily placed directly behind the steam dome, the sand box, the bell and the stack, cutting off most of the sound which should be thrown ahead of the engine instead of out to the side and behind it? The whistle, says Professor Foley, Head of the Department of Physics at the University of Indiana, writing in *Railway Age* (New York), should be placed directly on the front of the locomotive and should be provided with a sound reflector so that the warning signal will be thrown strongly in advance where it can be heard by motorists seated within closed cars.

Doubtless, when locomotives first began to be common, nearly a century ago, the matter of placing the whistle on the locomotive was of trifling moment. There were then few competing noises. Today the motor car has changed the situation. The locomotive whistle is now important as a warning. Yet such is the conservatism of railroad men that the obviously detrimental habit of placing the whistle in the wrong place has lived on for decades.

Professor Foley estimates that it is costing us the price of 4,000,000 tons of coal yearly to blow whistles which could be blown to better advantage and with far less expenditure of energy if the whistles were not masked and muffled by the various obstructions mentioned above. He says that "the location of a locomotive whistle is usually about as bad as if it were placed inside the cab or under the locomotive itself."

Bearing quite directly on this situation is the fact that for many months the railway journals have contained a running discussion of the lack of college trained men with new ideas and a fresh point of view, in the railroading profession. The college man unlike the present-day railroad man has not been brought up for years in a circle whose traditions are so strong that they tend to crush out originality. At the present time extremely few railroad executives are col-



The Northrup high-frequency furnace at the United States Bureau of Standards

lege men, and even if the railroads are beginning to discover their lack in this respect, the young college graduate with few exceptions has proved unwilling to enter the organization of the average railroad company because he feels that nearly every hand will be set against him. Men who have slowly worked their way up from yard foreman to superintendent or from telegraph operator to president do not as a rule take kindly to the college man. They feel that he does not know what they call "good railroading" which is to be learned only by about forty years of actual experience on the railroads. So the whistle, along with many other similar details of the railroad world, still remains where it has always been.

With his new whistles and reflectors, Professor Foley conducted some interesting tests. He took a locomotive placed it on a turntable, put a man in the cab to blow the whistle, and then drove in a closed car to a distance of 1,200 feet, stopped the car but not the motor and listened whenever the whistle was blown. From time to time the locomotive was turned farther around on its turn-table, thus simulating the average conditions of audibility of a whistle all around the horizon. He found that the sound of the whistle is nearly three times as intense on either side of the locomotive as it is ahead, where it ought to be loudest. He proposes not only to remove the whistle to the very front of the engine, but to place it in a simple sound reflector like a bowl. As the second diagram shows, the audibility would then become four times as great in front as in the rear. "Even a mule knows that sound can be reflected," says the Professor, "for the mule turns his ears in the direction from which the sound comes."

We reproduce from Professor Foley's article a diagram showing the relative intensity (dotted line) of sound all round the horizon from a locomotive having its whistle placed in the usual position, also a diagram showing the relative intensity when the whistle is placed on the head of the engine and in a reflector. It will be noted that in the first diagram, showing the present conditions, the sound is actually *stronger behind the locomotive than in front of it,* and two or three times as intense at right angles to the track as along the track.

To make matters worse, when the locomotive is running (as it was not in these tests) the exhaust steam and smoke and hot convection currents from the boiler are swept back over the locomotive, absorbing much of the energy of the whistle. "If anyone doubts this statement," asserts the Professor, "let him stand on one side of a bonfire and talk to someone on the other side. He may fail to make himself heard at all." This is due to the fact that a part of the energy of a sound wave is reflected when it falls upon a stream of hot gases.

Benjamin Franklin's homily about "paying too much for the whistle" becomes apposite when we read that a locomotive whistling two minutes out of each hour thus consumes 30 extra pounds of coal and 275 pounds of water hourly. The smaller but correctly located whistle advocated by Professor Foley would consume much less if given a chance to work at its best advantage.

Some railroad men have already objected to Professor Foley's plan, stating that the whistle is not merely a warning to motorists, but is a signal which must also be heard by the brakeman at the rear of the train. Yet the two diagrams show that with the whistle placed in front of the stack and within a reflector there would still be as great audibility behind the train as there now is in front.

Thus for nearly a century the railroads have been whistling backwards.

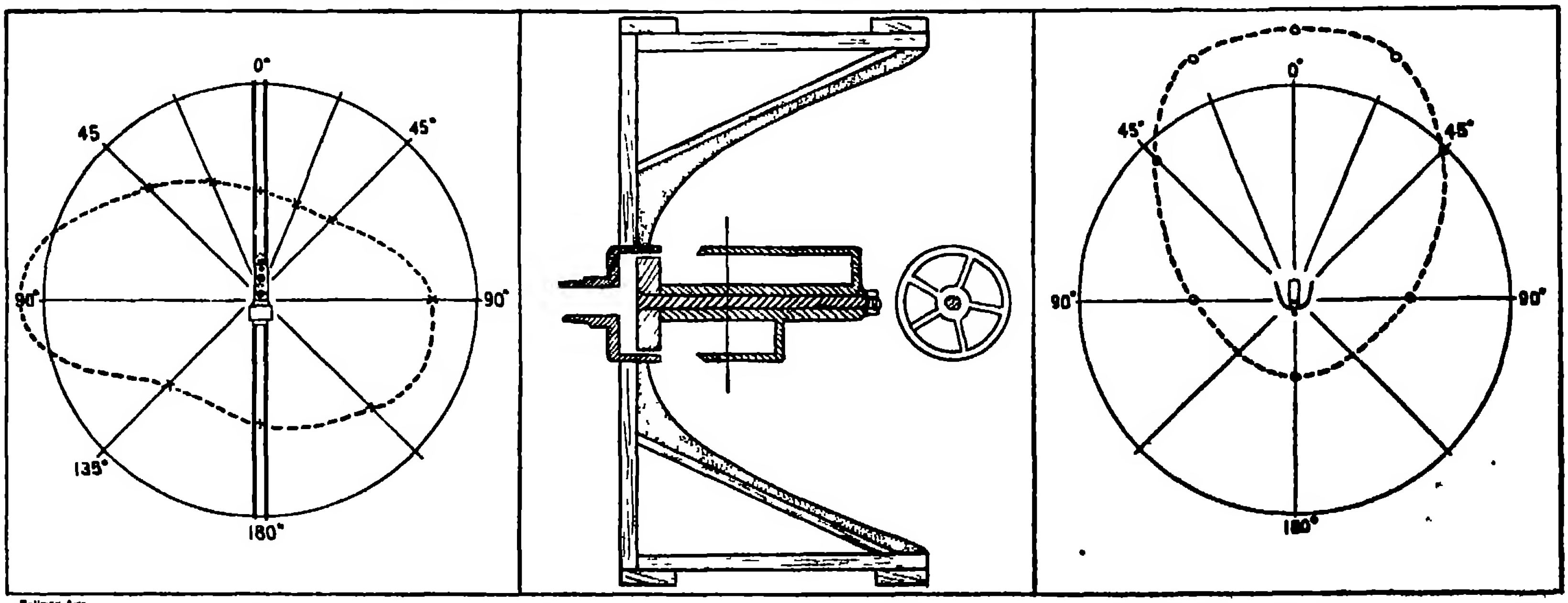
• • •

Radio-Operated Furnace Melts Precious Metals

A NEW 1½ kilowatt radio-operated furnace for melting platinum and other metals has just been installed in the Metallurgical Division of the United States Bureau of Standards at Washington, according to a short article furnished by S. R. Winters. The vacuum tubes used in this apparatus are identical in shape, size and characteristics with many of the electron tubes found at any radio broadcasting station. Six 250-watt transmitting electron tubes are employed. The 110-volt, 60-cycle electric house lighting system is the sole source of power, no motor generator batteries or other current supply being required.

The purpose of this high frequency converter is to change the 60-cycle electric lighting current into one of high frequency—on the order of 300,000 cycles per second. This frequency or wavelength is employed to raise heat for the melting of platinum, gold, or other precious metals, instead of being used as a medium for radio signaling. In the production of pure platinum, for example, this type of furnace is peculiarly fitted, and little difficulty is experienced in reaching a heat of 3,000 degrees Centigrade (5,430 degrees, Fahrenheit).

This variety of furnace, the invention of Dr. Edwin F. Northrup of Princeton University, is capable of heating with marked rapidity. A crucible filled with graphite can



Railway Age

Left: The curve of sound intensity surrounding a locomotive whistle mounted according to the present custom. The locomotive is shown in the circle. *Center:* Sections of a chime whistle mounted in the advocated sound reflector. *Right:* The effect of a sound reflector. The dotted curve shows where the sound is heard best

be subjected to a temperature of 4,500 degrees, Fahrenheit, in less than 20 minutes. Yet, with this degree of heat on the inside of a steel furnace, the temperature on the outside is not likely to exceed 212 degrees, Fahrenheit,—a condition contributing to the operator's comfort, especially during the summer months. The capacity of a powerful furnace of this type—for example, when operated by a 20-kilowatt, high frequency converter,—is suggested by its achievement of melting 85 pounds of copper per hour, or between 500 and 700 pounds of this metal in the course of eight hours.

The Northrup high frequency furnace works on the principle of a transformer in which the primary is a conductor, in the form of a coil of copper wire or tubing, and the secondary is a mass of conducting material within the coil. The current within the primary coil does not heat up much above room temperature, the coil being water cooled, but the mass within it, forming its secondary, is rapidly heated to a high degree. Thus, this type of furnace should be thought of as a transformer in which, instead of attempting to reduce heating effects to a minimum, as is the case with the ordinary transformer, these effects are exploited as fully as possible. As a transformer it would be highly inefficient. Regarded as a heating furnace it is highly efficient and effective.

The high-frequency converter sometimes produces interference with the reception of radio communications. The amount of disturbance caused by this radio-operated furnace is a disputed question, some claiming that it is considerable, while others maintain that it is a negligible quantity.

Strange to say, this same furnace may be employed for increasing the efficiency of the vacuum tubes used in radio receiving sets. Quite recently, in fact, licenses were issued by the Government to the General Electric Company, the Western Electric Company and to the Westinghouse Electric and Manufacturing Company, permitting them to manufacture high frequency apparatus for heating the interior parts of vacuum tubes while gases are being expelled. Gases in the metal parts of such tubes are said to be more readily driven off by the induction method just described than by applying heat to them during evacuation—the former method.

The converter, which transforms the 60-cycle electric current into high frequencies, is enclosed in a metal cage. On its face is a switchboard, containing a wheel for controlling the electric power and indicating wattmeter. The three essential units of this converter are enclosed in the cage. These are: the condensers, a transformer, and a discharge gap. The latter has two electrodes which are raised and lowered over a surface of mercury held in a metal container. A hand wheel on the face of the switchboard is manipulated for raising and lowering the electrodes. The power delivered by this converter may be varied from zero to many kilowatts by changing the distance of these electrodes above the surface of the mercury. The transformer steps the line voltage up to 6,000 volts.

* * *

Fat Sweet Potatoes

CONTRARY to popular belief, the day of chance discoveries is not entirely past. Perhaps the latest case is that of controlling the shape of sweet potatoes by using certain fertilizing elements.

In 1921, while digging sweet potatoes to measure the influence of different amounts and kinds of fertilizers on yields, L. G. Schermerhorn of the New Jersey Agricultural Experiment Station observed a marked difference in the shape of tubers coming from the various plots on which they were being grown. Schermerhorn at once followed the clue which pointed to fertilizer influence.

This was a rather startling discovery, since both growers and scientists have always considered such variations a natural phenomenon beyond human control, like the shape of leaves or the color of an animal's eye.

Four years of subsequent tests finally proved that potash will influence the shape of sweet potatoes. A fertilizer containing but a small percentage of potash produces a large number of spindly tubers. Within limits, increasing the amount of potash increases the number of chunky tubers. The common commercial fertilizer containing 3 units of nitrogen, 8 units of phosphoric acid and 8 units of potash, and known to the trade as a "3-8-8," was found to be the most economical from the standpoint of producing the most chunky tubers at the least cost. In other states than New Jersey, where the experimental work was done, differences in soil and climate may require a slightly different proportion of potash.

What this discovery will mean to sweet potato growers in guiding their use of fertilizers may be seen in the average results obtained in Schermerhorn's tests. Fertilizers with no potash gave such a large percentage of spindly tubers that only 100 bushels an acre were marketable. The same quantity of a 3-8-8 with its 8 per cent of potash, gave 152 bushels per acre—a 52 percent increase.


The plot treated with a fertilizer containing eight percent of potash produced these desirably-shaped potatoes

This discovery if made use of by the larger sweet potato growers, will mean to them a saving of hundreds of thousands of dollars a year.

* * *

A Warning to Amateur Telescope Makers

IN the Scientific American book, "Amateur Telescope Making," pages 15 and 19, the telescope maker was advised to coat his mirror, after silvering it, with a lacquer diluted six to one with amyl acetate. In certain cases, lacquer diluted at the ratio of only two to one has been supplied. The latter ratio of dilution is that which is nearly always used when this lacquer is applied to silverware, but it is too thick for telescope mirrors.

The manufacturer of the lacquer was visited and, when fully acquainted with the peculiar requirement, stated in a very friendly manner that since so great a dilution was very unusual it was possible that the thicker lacquer had been sent to our telescope makers in some cases by well intentioned employees. It should be obvious, however to anyone that these manufacturers have displayed considerable patience, and a desire to aid science, in filling hundreds of small, one-dollar orders requiring special packing, and so on, since they ordinarily deal in much greater quantities of lacquer.

To enable the telescope maker to decide whether or not his lacquer is sufficiently diluted the writer made a small experiment, with the following results. Lacquer diluted at two to one is almost as thick, in the can, as olive oil. It flows in an almost unbroken stream from a small stick and when poured over a test piece of glass it runs down quite deliberately. Lacquer diluted six or eight to one is nearly as thin as water, drops from a stick by drops and quickly runs down a pane of glass. If found in two to one dilution an ounce of amyl acetate may be obtained from the drug store for a few cents and the proper dilution made.

Several amateurs have expressed fear that lacquer will injure the optical qualities of their mirrors. This method of protecting them is not however a novelty. It was first tried at the Paris Observatory and, according to Bell, in his excellent book "The Telescope," (McGraw Hill Book Co.), it has been in use since 1913 at the Harvard Observatory, particularly on the 24-inch reflector. R. W. Porter has also used it for years and confirms the authorities mentioned above. However, Bell emphasizes strongly that it must not be used too thick. He recommends a six to one, or even an eight to one dilution.

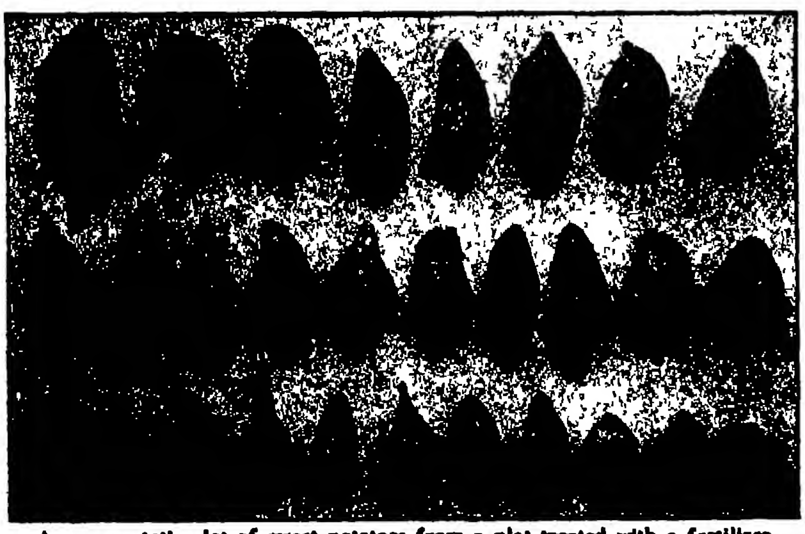
Inquiries received indicate the advisability of issuing another warning. In making the Foucault test the lamp should remain stationary. If moved with the knife-edge, the formula used (page 62, "Amateur Telescope Making") will bring about a serious case of over-correction of the mirror doubling the desired correction unless changed to r^2 over 2R.

* * *

Most Powerful Narrow Gage Locomotive in Existence

THE engineers who located our western railroads, through the Rockies and the Cascade Mountains, found themselves confronted at times with a bewildering task. If the roads were to handle the heavy passenger and freight trains which would be required as the country developed it was necessary to keep the grades down below certain limits. Hence, in crossing the mountains, the engineer, in order to develop his line with reasonable grades, frequently had to gain distance by swinging his line to and fro up the mountainside until when he had reached the top, the distance traversed by his located line, in extreme cases, would be many times as great as the distance measured in an airline from valley to summit.

Nowhere was more difficult mountain country encountered than in the territory covered by the lines of the Denver & Rio Grande Western Railway. So costly was the construction that it was decided to reduce the gage from 4 feet 8½ inches to 3 feet. For many years the system remained


A representative lot of sweet potatoes from a plot treated with a fertilizer containing six percent of potash


Representative lot of sweet potatoes grown on a plot treated with a non-potash fertilizer. Many of the tubers are spindly

Broad gage mountain locomotive used on the mountain division of the Denver and Rio Grande Western Railroad. Weight, engine and tender, loaded, 644,600 pounds; cylinders, 28 inches by 30 inches; horsepower, 3,300

The heaviest narrow-gage locomotive. Built for hauling trains over severe mountain grades of the D. and R. G. Western Railroad. Total weight, loaded, 286,600 pounds; cylinders, 20 inches by 24 inches; horsepower, 1,410

narrow gage but gradually as traffic increased the lines have been changed from narrow to broad gage until only certain sections of the 3-foot gage system are now in operation.

We show a profile of a portion of the narrow gage line on the route from Denver to Durango commencing at Alamosa and extending to Arboles. It will be seen that not only are the grades heavy, the maximum varying on certain stretches of the line from 1.42 percent to 4 percent, but the curvature of the line is also extremely severe, the maximum varying from curves of 10 degrees to as high as 20 degrees. We direct particular attention to the section of line between Chama and the summit at Cumbres, where there is a grade of 4 percent and the maximum curves are 20 degrees. Moreover the whole amount of curvature is 3523 degrees, or nearly ten complete circles.

The great difficulty of operating freight and passenger trains over lines with heavy grades and curvature will be understood from the fact that the principal roads of the country have spent hundreds of millions of dollars during the past twenty-five years in taking the curvature out of their lines and in cutting down the grades so that on some systems a grade of 1.5 percent and 5 degree curves are the maximum. So difficult is the country through which this narrow gage line runs that any such reduction of curvature and grades would be prohibitive, not only because of physical difficulties but because of the cost.

We present illustrations of the two latest and most powerful locomotives which are operating trains over the mountain divisions of the Denver & Rio Grande, the one being used for narrow-gage operation and the other on the broad gage lines. The narrow gage locomotive is the most powerful of its kind in existence, and it is really remarkable that so much weight and power could be assembled in an engine capable of operating on track only 3 feet wide, especially when we remember that it has to run around curves of as high as 20 degrees. The secret of its stability lies in the fact that in spite of the height and bulk of the locomotive its center of gravity, because of the great weight of cylinders, frames, wheels and driving gear, lies very low down. Moreover stability is further assured by giving a high superelevation of several inches to the outside rail of the curves.

The total weight of the engine and tender loaded is 286,600 pounds. How great is the increase in weight and power of a broad gage engine due to the larger dimensions is seen by a comparison of this narrow gage locomotive with the latest broad gage locomotive built for mountain service, for the whole weight of the engine and tender loaded is 644,600 pounds.

We present herewith in parallel columns the principal items of the two locomotives. It will be seen that in the broad gage type the cylinder dimensions as compared with the narrow gage have gone up from 20 inches by 24 inches to 28 inches by 30 inches; that the length over all has increased from 67½ feet to 95 feet, the height from 13¼ feet to 16 feet, and the width from just under 10 feet to over 11 feet. The narrow gage tender carries 5,000 gallons of water and the broad gage 14,000 gallons, and the load of coal has increased from 8 tons to 22 tons.

Comparison Narrow and Broad Gage Locomotive
Denver & Rio Grande Western Railroad

	NARROW GAGE	BROAD GAGE
Cylinders	20 ins. Diam., 24 in. Stroke	28 ins. Diam., 30 in. Stroke
Driving Wheel	44 ins. Diam.	63 ins. Diam.
Boiler Pressure	195 lbs. per sq. in.	210 lbs. per sq. in.
Length Over All	67 ft. 5¾ ins.	95 ft.
Height	13 ft. 4 ins.	16 ft.
Width Over All	10 ft.	11 ft. 2¼ ins.
Weight on Drivers	143,850 lbs.	257,500 lbs.
Total Weight of Engine	187,100 lbs.	377,000 lbs.
Engine and Tender Loaded	286,600 lbs.	644,600 lbs.
Capacity of Tender	5,000 gals. Water 8 tons Coal	14,000 gals. Water 22 tons Coal
Horsepower of Boiler	1,410	3,300

"Hooch," "Home Brew" and Copper

Such is the title under which the *Journal of the American Medical Association* (Chicago) points out that copper should not be employed where it may come in contact with foods or drinks, especially if they contain acids of any sort. Copper, it is stated, is readily dissolved by many of them and is liable to bring about the symptom complex known under the different names of hemochromatosis, bronzed diabetes and pigment cirrhosis.

As a consequence of modern economic and social changes, the latent dangers of poisoning from certain heavy metals are now suddenly presented to the public at large. Gasoline, says this noted medical journal in an editorial, brought about nation-wide concern about lead. Suicides and syphilis awakened a new interest in mercury. And now the bootlegger brings copper to our toxicologic attention.

As medical authorities point out, the fact that our organs on chemical examination show a certain amount of copper does not mean that we are all suffering from copper poisoning, for it seems that we can handle five to ten one-thousandths of a gram of copper per day. If, however, the amount absorbed exceeds a certain definite limit, the danger of pigmentation of the liver and pancreas is evident. Chemists have demonstrated that present-day distilled liquors may contain as much as 173 one-thousandths of a gram of copper per quart, while samples of "home brew" have been found to show the presence of 23 one-thousandths of a gram per quart.

It is pointed out that the introduction of the copper into the drink is due to the action of organic acids in the mash distilling over with the alcohol and acting on the worm of the condenser when it is made of copper. Cocktail shakers of copper or brass, lined with silver or tin, come in for part of the incrimination. When the plating of these receptacles wears off or dissolves the acids readily attack the copper. But on the shoulders of the "old Demon Rum," about which sentimentalists have raved for centuries, does not fall all of the medical journal's obloquy. It is pointed out that lemonade containing acids is usually shaken in copper shakers at soda fountains and that copper pots and kettles also find use in the kitchen.

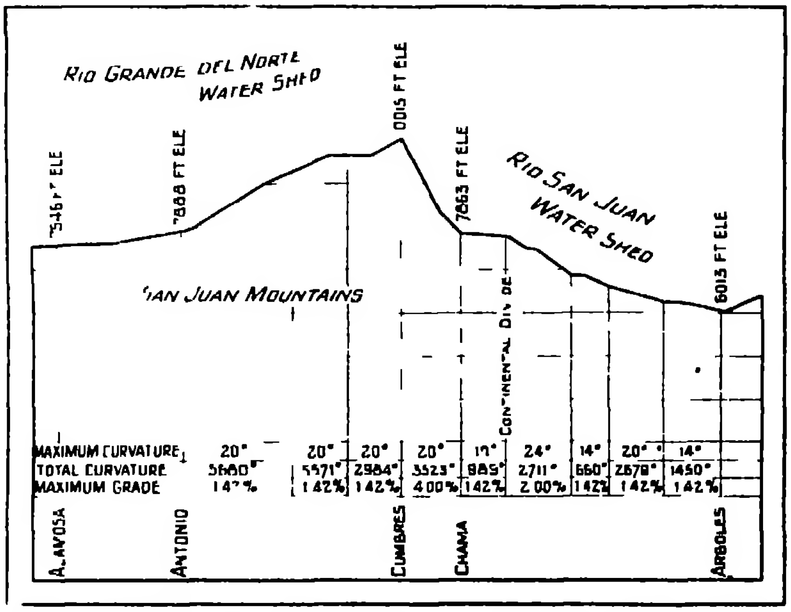
The advice of the medical authorities who warn us about these dangers seem wholesome, says the medical journal, and continues, "copper should not be employed where it may come in contact with foods or drinks, especially if they contain acids of any sort because it is readily dissolved by many of them."

* * *

Not A Buried Treasure Finder

In the December 1925 issue of the Scientific American we published a brief non-technical summary and critique of the several methods of prospecting from above ground, for ores, oil and so on. One of the methods mentioned was that which employs the torsion or gravity balance. This instrument determines slight variations in the density of the rocks beneath the surface, and in that manner it has proved to be of great assistance in locating large, valuable deposits of mineral and oil.

We have now received for review a brief treatise entitled "The Eotvos Torsion Balance," published by one of the manufacturers of these delicate instruments, L. Oertling Ltd., London, England. This work of about 100 pages describes the instrument, the method of observing, the planning of the survey and so on. To quite a degree, it is mathematical. The use of the torsion balance requires training, not only in higher mathematics, but in geology. The instrument costs several thousand dollars. It is now in regular use, especially by the large oil companies, but it does *not* locate "buried treasure."



Profile of difficult narrow-gage line of Denver and Rio Grande Western Railroad across the mountain divide where the grades reach four percent and the curves run as high as 20 and 24 degrees

Radio Notes

A Review and Commentary on the Progress in This Branch of Rapid Communication

Conducted by Orrin E. Dunlap, Jr.

Herbert Photos

A modern ship's radio receiver. Square bakelite jackets protect the coils of the S.S. *Hamburg's* receiving set. Note the flexible wooden washers which insulate the high-frequency wires used for plugging into the jacks on the panel behind the operator. Each jack corresponds to a different wavelength to which the transmitter can be tuned

Television Near Says Engineer

TELEVISION is within the grasp of research engineers and before a period of five years has passed, it will be possible to equip transmitting and receiving stations so that listeners can see what is transpiring before the microphone, according to Harry Sadenwater, chief engineer of stations WGY, KOA and KGO

"But I do not believe we want to do both television and radio telephony simultaneously," Mr. Sadenwater told the Radio Club of America "If a story is skilfully told or a musical program is skilfully presented, the entire performance is much more beautiful if the actual scenes and the appearance of the artists are left to the imagination, so the listener can form his own pleasing picture of the heroine and the most villainous-looking scoundrel, and not have the opposite types appear because the personalities were best suited by voice characteristics for a particular part"

Receiving Licenses for Bay City

AN ordinance to regulate the operation of radio receivers has been passed by Bay City, Michigan. It provides that no citizen can operate a receiver without a license, the fee for which is two dollars. Violations are punishable by a fine of not in excess of one hundred dollars and imprisonment for three months or either A third violation brings about a revocation of the license.

Weather and Fading

HERTZIAN wave propagation tests conducted by the General Electric Company at Schenectady, New York, with the cooperation of radio fans in various sections of the United States, revealed that barometric pressure and weather have only a minor influence upon broadcasting. However, the data show that signals received at short distances are stronger when they have come through a region of even pressure, than when they have traveled from a high to a low pressure area or vice versa. At distances of more than 400 miles the conditions along the surface of the earth seem to have little if any effect.

In connection with the weather tests, observations were made on fading, and it was found that there is a change in conditions from January to February In the study of January reports, it was discovered that most of the bad fading was found in a definite region between 200 and 400 miles from the transmitter The February reports indicated that equally bad fading occurred at all distances beyond 200 miles and was not confined to any particular zone. Ten percent of the reports record bad fading, 35 percent slight fading and 55 percent no fading.

It seems that radio reception everywhere is poorer in February than in January and the engineers believe this due to some change in the upper atmosphere rather than a change in weather conditions along the surface of the earth.

Split-Wave Theory

DATA secured and compiled by the engineers at WGY prove the theory that radio waves split into a ground and sky wave in passage from a transmitter to a receiver According to the split-wave theory, one wave passes along the ground and the other travels 100 miles or so above the surface of the earth where it is reflected back by a semi-conducting surface in the upper atmosphere. The ground wave weakens rapidly and becomes negligible about 200 miles from the broadcasting station. Reception at greater distances is due entirely to the sky wave.

Exclusive Radio Shop Doomed, Says Retailer

EXCLUSIVE radio stores will be a thing of the past within a year or two is the opinion of J. W Griffin, President of one of New York's largest exclusive radio retail organizations.

In an address before the Radio Manufacturers' Association, he said, "This is true because during the last three years the seasonal nature of radio has become more and more marked. The season has become shorter at both ends, and the break between the months of good business and bad business more and more sharply defined. The radio business as a business probably begins about Columbus Day, October 12, and it is pretty nearly all finished by St. Patrick's Day, March 17.

"Enough business may be gained during these few months to show a small profit for the year," said Mr. Griffin, "if added to the small sales that may be eked out of portable sets and accessories during the summer. But this is an immense waste of space facilities and energy during the summer, which should certainly be applied to some good purpose."

Mr. Griffin said that the successful dealers of the future will handle some other lines of merchandise which will find a demand from March to October.

WEAF Incorporated

STATION WEAF and the radio broadcasting activities of the American Telephone and Telegraph Company are now known as "The Broadcasting Company of America." The reason for the incorporation, it was announced, is that the radio problems differ from those of regular telephone operation and can therefore be more effectively handled by a separate organization.

Radio-Compass Bearings Free in United States

THE United States radio-compass stations furnish bearings to mariners free of charge. The British charge \$1.25 a bearing; France, \$1.20 and Sweden, \$1.30. The United States Navy compass stations furnished 126,606 bearings during the last fiscal year.

May Discontinue Standard Tests

THE Bureau of Standards is considering the termination of the broadcasting of standard frequency signals, partly because of the increasing use of piezo oscillators and the wide availability of reliable testing services at a number of laboratories that do commercial testing of frequency meters. The piezo crystals hold the station on its exact wavelength.

Radio Increases Current Consumption

DEVELOPMENT of radio receivers which dispense with batteries and employ the house lighting current, together with the fact that broadcast entertainment keeps people at home, is resulting in larger consumption of electricity, according to David Sarnoff, Vice-President and General Manager of the Radio Corporation of America.

"The types of broadcast receivers which now operate completely from the lighting circuit require up to 200 watts for their operation," said Mr Sarnoff. "The numerous power accessories on the market require from seven to fifty watts. It is reasonable to assume that within the next three or five years, by far the larger percentage of broadcast receivers will draw their local source of energy from the lighting socket. It is estimated that the average of such receivers will consume energy at the rate of eight kilowatt-hours a month.

"Radio is keeping the people at home. We have all known in a general way that this has resulted in larger monthly current bills."

Princeton Station Talked with Hawaii

THE Princeton University Radio Club's 80-meter transmitter has been heard in Toulouse, London, Cape Town and New Zealand, and two-way communication was established on one occasion with an amateur station in Honolulu. The Princeton call is 8 DH.

At the beginning of each college year a call is made for membership in the radio club and all members of the undergraduate body may qualify.

Sun Spots Blamed

Very few American broadcasting stations were heard in England during the past year compared with the records of other seasons. Foremost among the theories advanced to account for a barrier to American programs in crossing the sea is that sun spots affect

Herbert Photos

A 500-watt continuous-wave transmitter operating on wavelengths from 300 to 700 meters serves as the voice of the Flettner rotorship *Baden-Baden*. Tuning of the set is accomplished by adjusting the clips on the spiral coil

the transmission. Scientists say that the sun spots cause electrical disturbances in the atmosphere, and they are looking forward with interest to observe the changes in conditions as the next maximum sun spot period approaches in 1928.

Long Distance Goal

A NEW 1000-watt Western Electric broadcasting plant has been installed at Caracas, Venezuela. It is operated by the Empresa Venezuelana Radiotelephonica. The call letters are AYRE and the wavelength 375 meters. The aerial site is at a high altitude, which is expected to favor long distance transmission.

Standardizing Equipment

STANDARDIZATION of radio equipment is being done by the radio section of the Associated Manufacturers of Electrical Supplies. This section is divided into numerous apparatus groups, each of which devotes its attention to some specific line of instruments, such as receiving sets, tubes and batteries. The various committees develop standards for the instruments with which they are concerned, and when their standards are completed they are submitted to the technical committee of the section, which studies them to make sure that they are consistent with the requirements of the industry.

Up to the present time thirty-one radio standards have been approved and many others including radio symbols for use in diagrams, are nearing completion. It is expected that within a comparatively short time most of the radio equipment will be standardized in this manner. The work however, will undoubtedly continue indefinitely because of the constant development in the science of radio communication.

Neutrodyne Uses House Current

A SIX TUBE neutrodyne circuit designed to operate directly on the alternating current of house lighting mains, dispensing with all batteries has been introduced by the Garod Radio Corporation.

Three dials are employed for tuning as in the case of the standard neutrodyne circuits. Two small knobs are provided to regulate the volume. One of these intensity controls governs a series condenser in the antenna circuit. The function of this is to aid in tuning in the lower wavelengths and to prevent overloading the detector. The other volume regulator is a high-value variable resistance shunted across the secondary of the first audio amplifying transformer.

One 216-B vacuum tube serves as the rectifier, three UX 112 tubes act as the first and second radio-frequency amplifiers, and first audio-frequency amplifier. The detector is a UV 199 and the last audio amplifier is a UX 210.

No hum from the alternating current could be noticed in the initial demonstration, and when asked regarding the life of

Harris & Ewing

The apparatus shown here has been designed by the Bureau of Standards for counting the tiny particles of matter by means of a receiving set. The electrons race across a wire and are counted by an adding machine. L. F. Curtiss, an expert on Gamma rays, is shown in the photograph

Wide World

J. D. Chisholm, inventor of a secret radio system. The experimental station is located at Birchington, England. The germ of the invention is said to be the receiving set which picks up the signals straight from the peak of the wave

the tubes. B. F Miessner, the engineer who designed the receiver, said that less current is consumed by the tubes from the lighting circuit than tubes ordinarily consume from batteries, and for that reason longer life could be expected.

Europe's Stations Are Classified

A NEW plan divides European broadcasting stations into two classes (1) Every country will receive one wavelength exclusive to itself; but in some cases a country may be given several of these exclusive channels, their needs being adjudged from the standpoint of population, geographical area or educational requirements. (2) Very low power stations, widely separated from each other, will work on exactly the same wavelength, without causing interference, either within the area which they are built to serve or outside that area Two or more transmitters working on identical wavelengths will be called "common wavelength" stations.

A Trickle Charger

A CHARGER that supplies current into a radio battery just fast enough to compensate for the energy drawn off and supplies that current while the radio set is in operation, has been developed by the General Electric Company It is known as a trickle charger

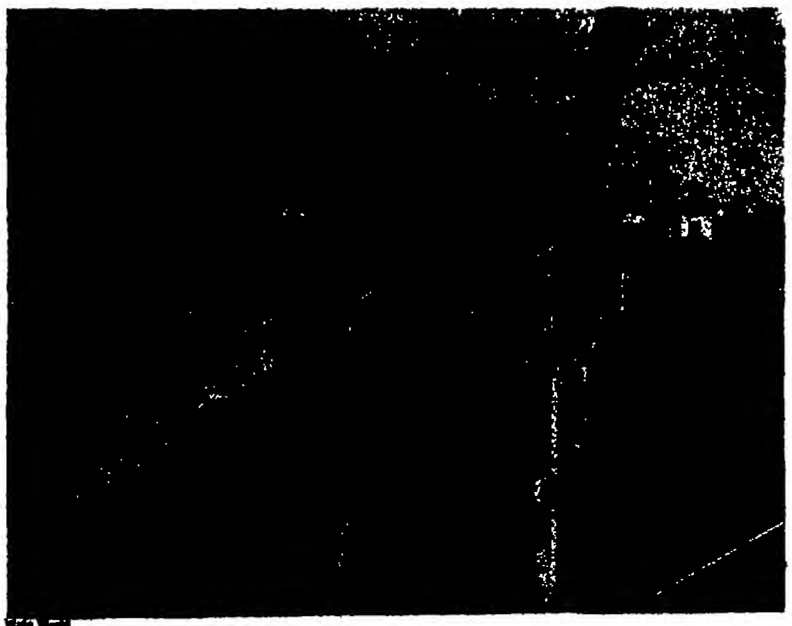
The engineers of the company contend that this device can be used twenty-four hours a day, as it does not disturb reception except on very sensitive sets. If the owner prefers to disconnect the charger during reception, it is merely necessary to pull out the plug which connects the device with the house lighting mains

The charger has four taps which provide three different low rates and a one half-ampere boosting rate, so that the exact rate required for any particular receiver can be obtained The device draws a slight amount of power from the line, only 14 watts being taken from the low tap and even with the boosting rate, the power consumed is but 27 watts.

50-146 Meter Stations

LIST of short wave stations of the United States and Hawaii between 50 and 146 meters.

Call	*Station*	*Meters*	*Power*
WBZ	Springfield, Mass	50	20KW
WQN	Rocky Point, N Y	51.5	20KW
KDKA	E. Pittsburgh, Pa	58.79	20KW
KDC	Casper, Wyo	59	500 W
WRB	Miami, Fla	68.4	100 W
WRP	Pinecrest, Fla.	68.8	5 W
WIR	New Br'swick, N J	74	20KW
KIO	Kahuku, Oahu	90	20KW
KEL	Bolinas, Cal	95	20KW
WGH	Tuckerton, N J	103	20KW
WOY	Springdale, Pa	137	100W



Wide World

The Chisholm secret radio transmitter. This installation can be heard only with a special receiver. The aerial masts are 100 feet in height

WDS	Pottsville, Pa.	137	500W
WLF	Wilsonville, Pa.	137	200W
WBI	Frackville, Pa	137	200W
WPH	Williamsport, Pa.	137	200W
WCJ	Hazleton, Pa.	137	100W
WHC	Allentown, Pa.	137	200W
WAV	Dearborn, Mich.	140	500W
WDY	Iron M'tain, Mich.	140	500W
WGF	Flint, Mich.	140	500W
KPG	Quanah, Texas	140	250W
KPP	P't'ble--Okla., Texas	140	100W
KPK	Oklahoma City	140	250W
KFWS	Br'sville, Texas	140	10W
KFWR	San Benito, Texas	140	10W
WDYC	Detroit, Mich.	140	500W
WJBF	Charleroi, Pa.	142	100W
WLQ	Baltimore, Md.	143	250W
WJX	Washington, D C.	143	50W
WJH	Washington, D C.	143,	50W
WEY	Boston, Mass	146	5W
KVP	Dallas, Texas	146	100W
KJA	Pyaht, Wash.	146	5W
KFZ	Portable—Cal.	146	50W
KGV	Portable—Cal.	146	50W
KYX	Portable—Cal.	146	500W
KZI	Portable—Cal.	146	500W
KJU	Culver City, Cal.	146	50W
KYY	Los Angeles, Cal.	146	500W
KFV	Portable—Cal.	146	300W

Supports for Radio

ELEMENTS of permanent support for broadcasting in the United States are becoming clearly defined in several categories according to David Sarnoff, Vice-President and General Manager of the Radio Corporation of America. They are (1) Contributions from the radio industry for the maintenance of broadcasting. (2) Good-will and indirect advertising over the air. (3) Organized educational support including appropriations from Boards of Education and college endowments. (4) Organized social support including endowments to promote public health and social service. (5) Community broadcasting by the Chamber of Commerce and other civic organizations to advertise the advantages of cities and states. (6) Institutional broadcasting for developing the prestige of firms by means of high-class radio entertainment.

Radio Shows Scheduled

LATE summer and fall will bring forth several radio shows, widely distributed over the United States and Canada. Here is a list of them:

August 21-28—Annual Pacific Radio Exposition, Exposition Auditorium, San Francisco, California.

September 10-17—Fifth National Radio Exposition, Grand Central Palace, New York.

September 13-18—Radio Manufacturers' Show, New Madison Square Garden, New York.

September 13-18—Winnipeg Radio Show, Alexander Hotel, Winnipeg, Canada.

September 27-October 2—National Radio Exposition, Chicago, Illinois.

October 4-9—Pittsburgh Radio Show, Pittsburgh, Pennsylvania.

October 4-9—Montreal Radio Show, Windsor Hotel, Montreal, Quebec, Canada.

October 11-17—Radio Manufacturers' Show, Coliseum, Chicago, Illinois.

October 25-30—Second annual Indianapolis Radio Exposition, State Fair Grounds, Indianapolis, Indiana

October 25-30—Radio Show, Coliseum, Toronto, Ontario, Canada.

Pictures Travel on Long Waves

BROADCAST listeners need have no fear that transatlantic radiophotograph transmission will intermingle with their musical programs. The pictures travel on wavelengths higher than 10,000 meters, while broadcasting stations operate between 200 and 550 meters. If it were possible for a broadcast receiver to tune in the pictures they would sound like dots and dashes. In the transmission of checks it would be difficult to distinguish between a dollar and a million dollars as far as the sound is concerned.

Time, Day and Date

STATION KGO, Oakland, California, signs-off with the time, day and date because of requests from listeners in the mountain and desert regions, who lose track of time.

Wide World

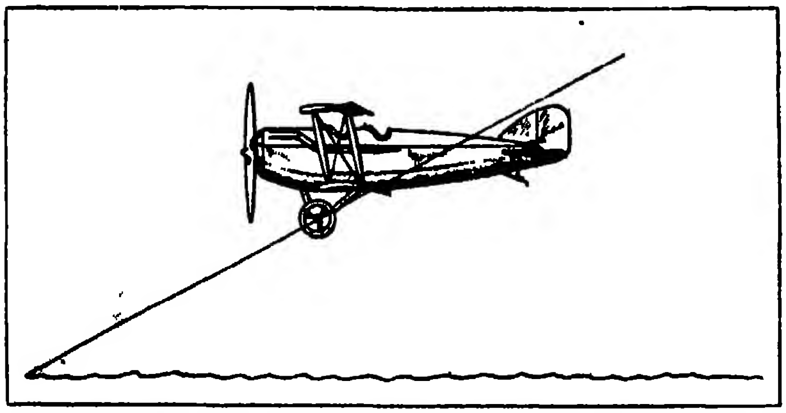
Dr. James Harris Rogers, of Hyattsville, Maryland, is shown here with the transmitter he uses for experimenting with underground antennas

Learning to Use Our Wings

Aircraft are being put to use in peace as well as in war. This department will keep our readers informed of the latest facts about airships and airplanes

Conducted by Alexander Klemin

In charge, Daniel Guggenheim School of Aeronautics, New York University

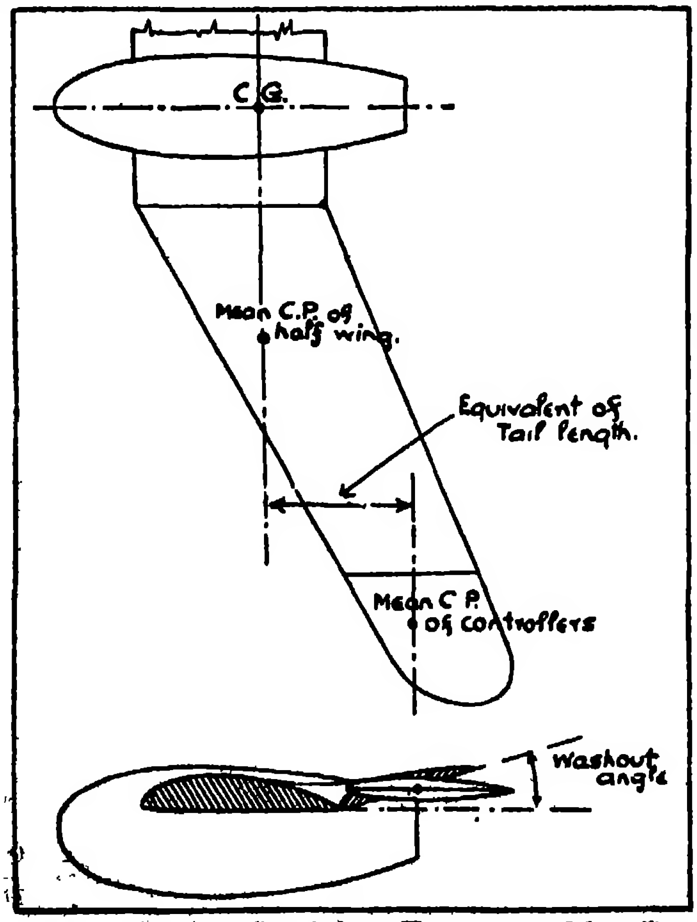


An airplane gliding down a steep path with its longitudinal axis horizontal; an ideal method of landing in a restricted field, if only control can be maintained when the wing is at such a large angle to the flight path

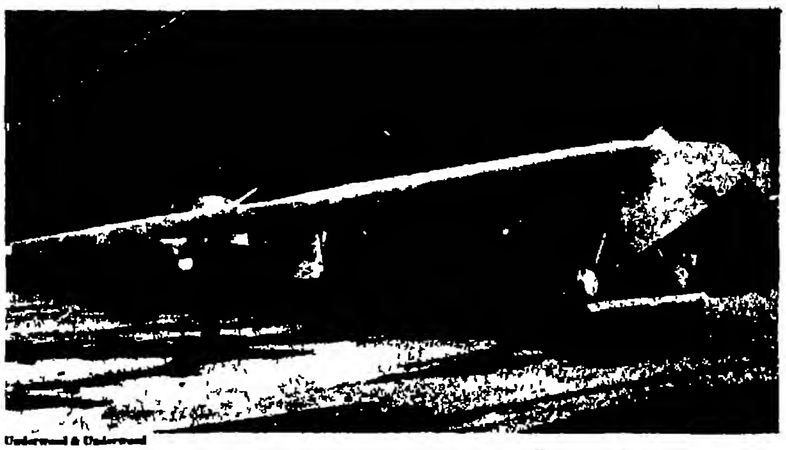
The Tailless Airplane

THE slower the landing speed of an airplane, the shorter will be the landing run, and the less the chance of disaster in an imperfect landing, or one made in rough ground. Unfortunately, even with a low landing speed, the pilot may have to make a long glide across the airdrome until he gets his machine in position for perfect three-point contact, the front wheels and the tail skid touching simultaneously In a small field, or one surrounded by obstacles, there arises the problem of losing altitude without covering too great a distance in a horizontal direction. Pilots often resort to such devices as side-slipping into the field or "fish tailing," a peculiar maneuver in which the pilot swings the tail of his plane from side to side. These maneuvers are not free from objection The pilot must be able to time the recovery from such maneuvers very accurately and an element of danger is always present.

In a restricted field therefore, it would be desirable to be able to glide in on a steep path—so as to lose altitude without going forward too much. But this does not mean that the pilot should glide steeply with the nose of his machine down He should glide steeply but with the axis of



A diagram of the Hill tailless airplane. The turning up of the trailing edge and the "wash out" at the tip, in combination with the sweep-back, give a constant position of the center of pressure always coinciding with the center of gravity. Note the controllers hinged at the very end of the wing



Underwood & Underwood

Front view of Captain Hill's wonderful tailless airplane

the machine almost horizontal The chance of a nose crash then would be very slight

Such a glide is theoretically possible with almost any machine flying at a large angle of attack to the path, in a so-called "stalled" condition as indicated in the diagram. Unfortunately in "stalled" flight, there is serious danger of loss of control

British statistics indicate that in the last few years, more than two-thirds of the fatal accidents have been associated with such loss of control

Within the ordinary range of flight angles, the lift increases as the angle between the wing and the line of the wind increases. Any loss of speed is compensated for by an increase in this angle But if this angle becomes too large, we reach a "stalled" condition, when further increase of the angle actually means loss of lift, and a violent drop of the airplane, which gives a flier the same painful sensation as a too rapidly dropping elevator The drag also increases rapidly and slows up the machine At the same time the center of pressure moves back violently, and the machine tends to go down by the nose.

At the same time, in the stalled condition the ailerons become largely inoperative, and when used to right a roll, tend to turn the machine off its path

In a "stall," accompanied by a slight roll, this combination of unfortunate circumstances very frequently acts to produce a spinning nose-dive, in which the machine glides steeply to earth, while spinning round and round about an axis which is nearly its longitudinal axis.

Every good pilot knows how to recover from a "stall spin." He depresses his elevators so as to diminish the angle of incidence on the wing and diminish the "stalled condition," puts his aileron and rudder control in neutral and waits. Given sufficient height above the ground, the recovery of normal flight attitude is bound to follow but if the height is insufficient, a bad crash may result.

A great advance in safety would follow if a machine could be designed which could be "unstalled" at will and in which all tendency to "spinning" would be immediately checked.

This long and perhaps tedious preamble is necessary, if the full significance of the Hill Tailless Airplane is to be appreciated

The tailless airplane is not entirely novel in its conception. The Burgess-Dunne, flown in the United States before the war, had swept back wings with the controls at the end of the tips and no fuselage.

Strictly speaking, the Hill *Pterodactyl* is not a tailless airplane at all Rather, the tail has been attached at the end of heavily swept back wings, and the projected length remains practically the same as in a conventional airplane

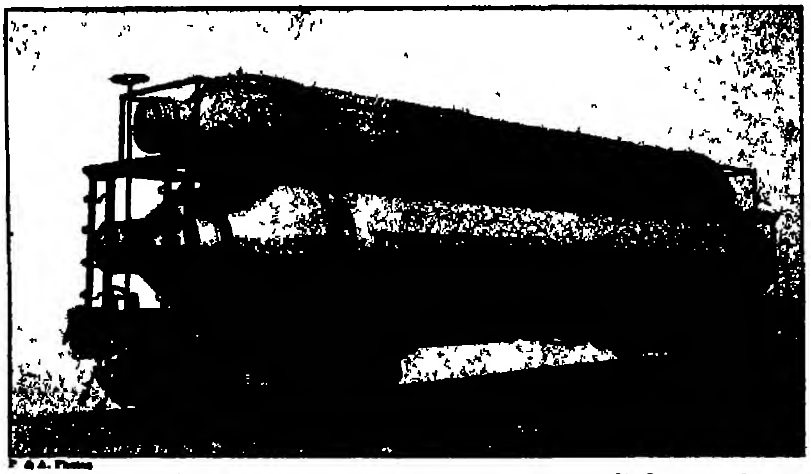
We show a diagrammatic sketch of this interesting machine and a photograph of the plane in the hangar

The wing is not only swept back, but also tapered in plan form The trailing edge of the wing is turned up, and at the same time its angle of incidence is diminished as compared with the central portions of the wing, or is "washed out" in airplane terminology

The turning up of the trailing edge in combination with the washout produces a constant center of pressure. In other words the violent tendency for the plane to nose-dive at the "stall" largely disappears.

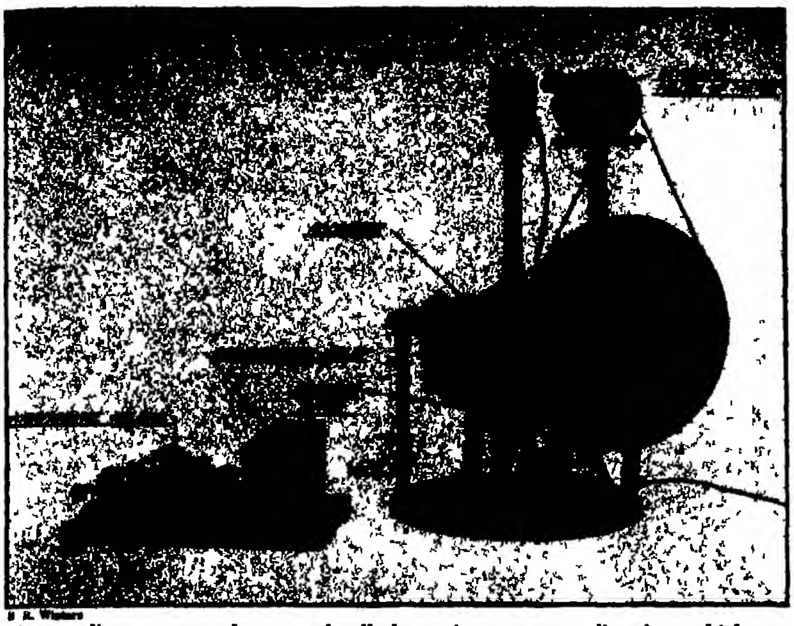
At the end of the fixed portion of the wing are placed two "controllers," symmetrically double cambered surfaces, balanced about their hinges. When depressed or raised simultaneously, the controllers act as elevators, and even though not at the end of the tail, they are far back from the center of gravity of the plane, and therefore have a powerful leverage. When used differentially, one turned up, and the other turned down, they act like ailerons.

Since the center of pressure on the wings is stationary, it always coincides with the center of gravity Therefore, no force is normally required on the controllers to "trim" the ship and the controllers can be so adjusted that they always lie neutrally in the wind



P & A. Photos

A new tank car for carrying helium gas. The three large cylinders contain gas under 2,000 pounds per square inch pressure, which, when expanded to atmospheric pressure, occupy 205,000 cubic feet



S. R. Winters

A recording compass that records all the various compass directions which an airplane may make in flight

With a conventional machine, when the wing is "stalled," the stabilizer is also at a large angle to the wind, and the elevators become inoperative just when their help is most required

Further we have seen that the ailerons at the "stalled" condition tend to spin the airplane. In the Hill *Pterodactyl*, since the controllers are always neutral they never lose their restoring power, and the resistance of the turned down "controller" is equal to the resistance of the turned up "controller." All tendency to spin is thus avoided.

As regards other features of the extraordinary craft, the usual fin and rudder have been replaced by two rudders placed at the point of attachment of the struts to the wings, and below the wings. Two fins are placed above the wing at the end of the fixed portion.

The body which has to carry no tail or tail skid loads, can be made very light and is actually built up of light balsa ply wood. In the absence of a tail-skid, the landing gear has three wheels, with the rear wheel carried on a fork and supplied with a locking gear which acts as a brake. Owing to the short wheel base, the machine pitches while on the ground and seems to be in danger of turning over As there is no fuselage, the plane is very conveniently arranged as a pusher, without the necessity of raising the thrust line far above the top of the fuselage. The *Pterodactyl* is equipped with a Bristol Cherub engine of 22 horsepower It has an overall span of 45 feet, the area of the main planes is 223 square feet, that of the controllers 55 square feet, and that of the two rudders 13 square feet The weight empty is 458 pounds and with gas, oil and pilot the weight is 658 pounds. The top speed is 70 miles per hour, and the minimum speed approximately 28 miles per hour As far as structural weight or performance goes, the tailless airplane does not seem to be superior to the ordinary light airplane.

The real interest of the *Pterodactyl* lies in its wonderful flying properties.

The machine, while having a definite minimum speed, has no apparent stalling point It can glide down on a path of 45 degrees and yet maintain its axis horizontal It can fly stalled and pass instantaneously to flight below the critical angle of incidence It can, at the slowest flying speeds, meet any lateral disturbance with ease and avoid the dreaded spinning nose dive.

While it is not at all probable that airplanes will henceforth be built in this tailless fashion, it is quite certain that the flying characteristics of the Hill *Pterodactyl* will be carefully studied, and those new aerodynamic principles applied to more conventional types of machines.

New Helium Tanks

THE sole source of supply of helium in the United States is at present at Fort Worth, Texas, *many miles from the airship* stations at Scott Field, Illinois, and Lakehurst, New Jersey The problem of supplying the vast quantities of helium required in operations is accordingly a difficult one At the request of the Army Air Service the Bethlehem Steel Company has constructed a special gas-carrying unit This unit is in the form of a tank car composed of three large cylinders. The three cylinders will carry 205,000 cubic feet of helium at a pressure of 2,000 pounds per square inch

Before the development of this tank car, the helium gas was carried in small cylinders, 1,200 of which were necessary to inflate an airship of 210,000 cubic feet capacity. In emptying the small cylinders *about 15 percent of the gas was lost through* leakage

The development of the large tanks not only reduces this waste, but cuts down the work involved in tapping a multiplicity of small cylinders.

A Recording Compass

THE Engineering Division of the Army Air Service has recently perfected a device which records on a paper chart, by means of pen and ink, all the various compass directions which an airplane may make in flight, no matter how intricate the variations in direction may be In a recent flight made from McCook Field, Dayton, Ohio, to Eaton, Pennsylvania, and then back to Dayton, the device recorded the direction of route throughout the trip with complete accuracy As far as we know this is the first recording compass ever constructed and it may have important applications in charting airways.

We illustrate various parts of the device, the chart which revolves by clockwork, the driving motor which actuates the pen, the reversing, follow up motor, relays and so forth.

Unfortunately the full details of the device have not as yet been disclosed. We can make shrewd guesses only

The compass, preferably of the earth inductor type, is placed at the tail end of the fuselage where it is free from disturbing magnetic fields. An electrical contact device works with the compass in such manner that as long as the airplane is heading due north, contact is broken When the airplane deviates from true north, contact is established, and the driving motor sets the recording pen in motion. But if the driving motor were to continue indefinitely at work the pen would end by marking an enormous deviation from the north. We imagine that simultaneously with the movement of the driving motor and the pen, the reversing,

A prize-winning design for an "artificial" metropolitan flying field

follow-up motor changes the position of electrical contact, so that when the driving motor has displaced the pen to an amount corresponding to the route deviation, contact is again broken and the movement ceases. Perhaps our readers may find an even more plausible explanation.

The Metropolitan Flying Field

NOW that commercial air transport is coming rapidly into being, the question of flying fields, readily accessible to city centers, becomes of paramount importance Good flying fields are apt to be either prohibitive in cost, too far from the center of a city or else, if well within city limits, to have poor approaches. Hence the offer of a prize of one hundred dollars to the students of the Beaux Arts Institute of New York for the best plan of an "artificial" metropolitan flying terminal

While Messrs. Brainerd and Hammarberg obtained only second prize, their design is a most interesting one It provides for a huge steel structure to be erected over steamship piers or railroad yards, sufficiently high to minimize approach dangers, and 1,000 feet square, providing ample alighting and get away space for a modern plane The structure would be provided with two levels, an upper level for flying operations, and a lower level for repair shops, gasoline filling stations, waiting rooms, etcetera. The lower level is to be provided with a cantilever extension to serve as a safety cage in case of mislanding. Specially designed lifts are to be provided for transferring planes from the landing deck to the service level. Many problems that would tax the ingenuity of inventors and engineers to the full remain to be solved in connection with a structure of this kind. But there is nothing fantastic or insuperable in these ideas.

It is estimated by experts that such a platform could handle 30,000 planes a year, which should be sufficient for some time to come!

A Projected Transatlantic Flight

THE recent spectacular flights over the North Pole have their value as a general stimulus to aeronautical interest But a flight across the Atlantic, non-stop from New York to Paris, planned to take place this summer, may have consequences of a more practical character The "Argonauts" a group of sport loving American business men, organized by Colonel H. E. Hartney, commander of the First Pursuit Squadron during the war, is financing the flight in generous fashion, sufficient to provide a really excellent plane, every special device that science has developed for purposes of navigation, and the best possible personnel obtainable

The plane is being built by Igor I Sikorsky a native of Russia, who built his first plane in 1910 and has since had a career of unbroken success with multi motored planes as his specialty A gentleman of the old school, Mr Sikorsky combines with real technical knowledge, a skill in piloting and a practical knowledge of flying operations. The man who is to take command of the plane is René Fonck, French "ace of aces," who has nearly a hundred planes to his credit in the great war. Alert, determined, coolheaded, a first-class engineer as well as a pilot, Fonck is just the man to add another laurel to his crown by such a flight

Captain René Fonck, of the French Army Air Service, hero of a hundred air battles, who is to pilot the S-35 in its projected non-stop flight from New York City to Paris

That the expedition is not wholly dependent on European talent is gratifying. The plane is being built on Long Island and the navigator and radio operator or assistant pilot are both to be former American navy men.

The route has been most carefully planned. The length of the flight is 3,655 miles from Roosevelt Field, Westbury, Long Island, to Le Bourget, the great airdrome just outside Paris. If all goes well, this distance is to be covered in 36 hours, at an average speed of over a hundred miles an hour. The plan is to leave Roosevelt Field in the

S-35, as the plane is called tentatively, at 5 o'clock in the evening, when the air is calm, sail over New York City, up to Boston and fly along the coast by night when the chances of head winds are slight The frequent beacons will provide night landmarks which would be absent over the North Atlantic. The course is then to Halifax, Cape Breton and Cape Bonavista, and the aviators will bid the continent goodbye at Newfoundland The S-35 will then fly along a great circle, the shortest path between two points on the earth's surface and coincident with the great steamship lane of the North Atlantic. After passing over the southeast tip of the coast of Ireland, Cornwall, Cherbourg and Havre, the S-35 is scheduled to reach Paris at 11 o'clock of the morning of the second day

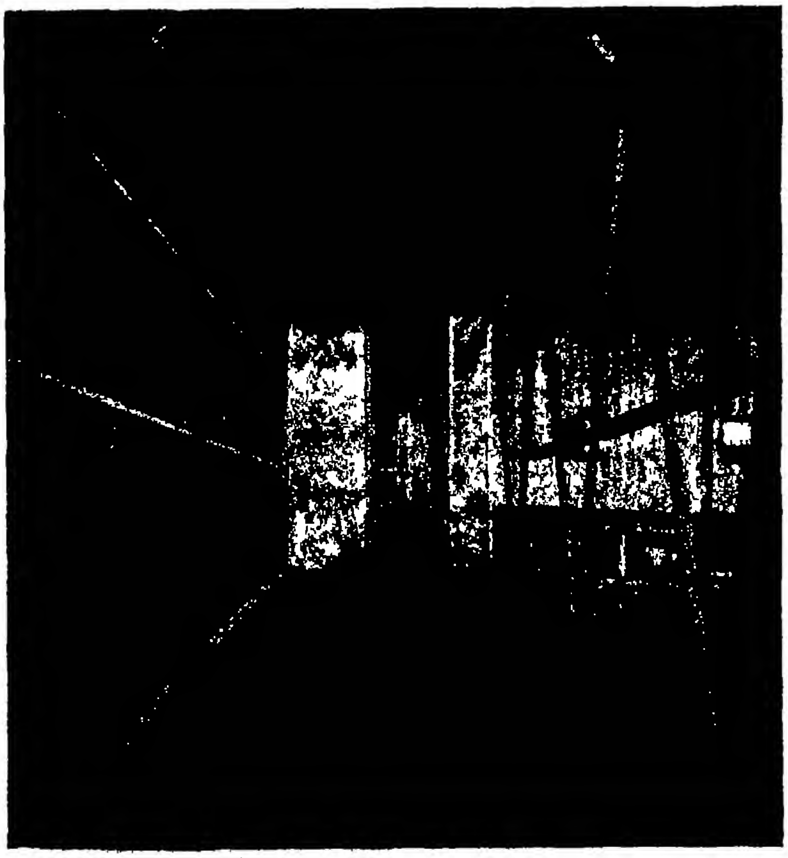
The great, technical difficulty in the design of the plane was the provision of sufficient gasoline for the 36 hours of projected flight, with sufficient reserve for untoward winds and other difficulties. The actual load of gasoline and oil provided in the huge tanks is 15,200 pounds or approximately 2,500 gallons. This is perhaps the largest amount of fuel carried aloft at any time in a heavier-than-air craft of any type.

Unfortunately in the airplane, it is not sufficient to increase the tank capacity to get greater flying range. The gross weight of the plane is severely restricted Endless calculation and innumerable changes in initial design were necessary before the problem of transporting this huge quantity of gas was solved The solution was finally reached by refinement of structure, so that with adequate structural safety, the S-35, with a gross weight of 24,000 pounds, only weighs 8,000 pounds empty of gas, oil and crew; and by the bold conception of loading the wings to their utmost capacity at the start of the flight The average mail plane is loaded to 10 pounds per square foot of its wing area The S-35 when it leaves Roosevelt Field will carry the unprecedented load of 21.85 pounds per square foot As fuel is consumed on the long journey this overload will gradually disappear But at the moment of departure, the plane will have to make an exceptionally long run and attain a far greater speed than is necessary with other modern airplanes. The get away will provide an anxious moment for the pilot Sikorsky and his associate engineers will heave a sigh of relief when Fonck has reached a reasonable altitude and flown his heavily loaded plane safely in the direction of Manhattan.

Throughout the journey, the pilot will watch his fuel gages carefully and compare them with the distance shown on his air-speed recorder, which replaces in the air the log of a seagoing vessel Careful calculation has determined that the best economy of the flight is to start with all motors in action, then to change to the two outboard motors as the load lightens, and subsequently throttle down the two motors still being used

One of the interesting technical points of the plane is that while heavily overloaded for this particular trip, it is in reality a practical passenger plane, which under normal circumstances can provide a passenger capacity of twelve in a comfortable cabin, or a freight capacity of 450 cubic feet. It can carry this load at a speed of approximately 140 miles per hour, which is perhaps the greatest speed ever planned for a passenger plane With a span of 101 feet for the upper wing, 76 feet for the lower plane and a total area of 1095 square feet, the S-35 is built entirely of metal Duralumin "I" sections and angles are used with the fabric cover as the only non-metallic material entering into the structure The plane as built for a record flight, will be entirely serviceable in commercial aviation

Special precautions for a forced landing in mid-ocean have been carefully provided but the greatest precaution against a forced landing is in the reliable power plant It has been sought to attain such reliability in a number of ways For example the fuel feed to the motors is by gravity from central gravity tanks containing four hours fuel supply The use of air-cooled air engines eliminates the troubles of water-cooling which are responsible, as a rule, for the majority of power plant failures The powerful Bristol Jupiter engines of 425 horse power each, are as reliable a type of aircraft engine as we have today and have passed the severest endurance tests. By far the greatest measure of security lies in the employment of three engines. Mr



The roomy interior of the cabin of the S-35 with its solid side trusses of duralumin channels. The rounded metal frames at the top complete the structure of the wing truss yet avoid the necessity of a single brace or wire in the cabin. At the rear is the door leading to the pilot's cockpit

Herbert Photos

Preparing for a long flight. Workmen assembling the *S-35* at the Sikorsky plant on Long Island. The huge craft is built entirely of the metal duralumin. Its structure is everywhere like that of a flying bridge. Note the solid "Warren" truss in the fuselage, a type familiar in every steel structure. Even the ribs, which maintain the outline of the wing, are built on the sound and tried principles of structural steel work. The illustration shows the central fuselage not yet covered with fabric, and the rigid engine mount at its front end

Sikorsky estimates that even at the beginning of the journey it will be possible to continue flight on any two of the three engines. At the end of the journey one *motor will suffice to maintain flight* Engine breakdowns of a simple character may therefore be remedied in flight by a skilled mechanic, and the probability of forced landing in mid-ocean become very remote indeed

However, Fonck, in spite of his heroic record, is cautious. Provision has been made fully for the improbable forced landing. Walls floor spaces and all convenient points in the fuselage have been stuffed with air bags which in addition to the emptied tanks can give indefinite flotation Radio transmission and receiving apparatus of short wave length with waterproof batteries, rockets, Very pistols and a collapsible floating mast guarantee means of communication with vessels passing within a wide range of the fliers Three collapsible rafts, such as used on the Byrd expedition will make it possible to pass from one point of the plane to another if any repairs are to be made while at sea.

Nor are special appliances lacking other than safety devices The navigator shooting the sun with his sextant, is protected from the rush of air by a special shield The magnificent American earth inductor compass and every other navigational appliance will be available The cockpit can be entirely inclosed in inclement weather A comfortable air mattress will invite sleep for the man off duty A French touch "attractive food supplies will be available, with hot chocolate, tea and coffee"

There is no doubt that the flight is of practical utility Success may be the precursor of regular mail service across the Atlantic. In commercial operation there undoubtedly would be intermediate stops between the two great cities. The lessened load of gasoline would allow a respectable pay load to be carried in the form of letters or possibly Paris hats of the very latest fashion

Beaching a Flying Boat

IN an interesting article in *Flight*, R J Mitchell discusses the ground operation of flying boats. Sometime in the future flying boats will undoubtedly reach a stage of development, where it will be possible to moor them for indefinite periods in a sheltered harbor, much as it is possible to moor an ordinary ocean going vessel They would then only go into dry-dock for extensive repairs. But as matters stand at present, wooden hulls and fabric covered wings make the flying boat too delicate for lengthy sojourn in the water, and in very windy weather they often tear from their moorings. Therefore it is customary to beach them as soon as possible after alighting.

Beaching a flying boat weighing several tons, and with a wing spread of sixty or seventy feet is not too easy a matter Any one who has tried to beach even a small motor boat will appreciate this thoroughly A variety of methods have been tried for easier beaching Very frequently a "beach cradle" is used This consists of a cradle mounted on swiveling wheels, which is made to fit the bottom of the hull amidships for a considerable portion of its length

Unfortunately the beach cradle takes up the weight of the hull through places not originally intended to take the loads. The bottom of the hull also forms a very narrow base for support in comparison with the span, and the flying boat has a tendency to rock while being handled, or even when at rest in a light breeze. Particularly dangerous is the moment when the cradle has been moved so far up shore, that the boat ceases to be water borne. As a result of these difficulties, more damage is caused to the flying boat while on the cradle than in the rest of its normal career

The development of amphibians has suggested a very different form of apparatus in the form of a special "beaching chassis." *The chassis is made in two parts, one to* fit each side of the hull. Each part consists of a light tubular frame built on a bent axle carrying an airplane wheel. An adjustable strut is pinned to the bent axle in such a manner that it is free to swivel and gradually release the hull until it rests on the ground. The "beaching chassis" is made to attach to those portions of the hull where the wing struts are attached, so that the transmission of loads occurs through a part of the hull which is designed to carry them normally It is readily seen that all the difficulties of the "beaching cradle" disappear The new "bleaching chassis" provides adequate support, a wide base which makes "rocking" impossible, and it is readily attached while the flying boat is still afloat.

It is with the development of such simple devices that ease of handling and the possibility of commercial operation of aircraft will come.

It is noteworthy that British seaplane operators have found it advisable to put roller skates under the "beaching chassis" and have thus moved the huge boats about sideways in closely packed hangars, without the usual backward, forward and sideways maneuvering!

Airplane Arresters

THE problem of restricting the travel of a rapidly moving airplane after it has once landed has long engaged the attention of aeronautical engineers. For ordinary land flying, a sufficiently short run has already been attained. For example, the latest type of mail plane, heavily loaded though it is with 1,000 pounds of mail, and 100 or more gallons of gas, will pull up in a distance of less than 300 feet. This has been achieved very simply by the employment of high lift wings, and a wing area which is large relative to the total weight of the airplane The provision of trailing edge flaps, or of Handley Page slots, which increase the lifting capacity of the wings at the moment of landing, will decrease the run still further Brakes on the wheels have been tried with some measure of success, although they entail the danger that if violently applied, the airplane may tip over on its nose But even without brakes on the wheels or any other special device, the landing run of the commercial airplane is already short enough for any but the smallest emergency fields.

On board an aircraft carrier, the distances available are necessarily very short, and there is still more reason why the plane should pull up short here than on land As long as it is in motion, there is always a danger of its going overboard in gusty weather

The first successful experiments with an arrester were made in 1911 when Eugene C Ely landed on the deck of the *U S S Pennsylvania* in San Francisco Bay Ely's airplane was equipped with hooks on the under carriage which engaged a series of wires, stretched athwartships and therefore at right angles to the path of the airplane These wires were connected to sand bags at either end The tendency to nose over was resisted by a long skid projecting ahead of the chassis.

In 1917, Hazen C. Pratt, a mechanical engineer of Rochester, attacked the problem systematically and soon formulated the following requirements for a successful arresting gear:

It must be of the simplest construction possible, complication increasing cost and the risk of failure

The apparatus carried by the airplane must be light in weight, must not add appreciably to the air resistance in flight, nor interfere with the normal functions of the airplane

A single engagement with the airplane must be relied upon to destroy speed and to maintain the plane in correct position, without the assistance of a front skid or wheel to prevent nosing over

In case of failure to engage, the pilot must be able to continue his flight, nothing would be more disastrous than to fail to make engagement yet to be unable to "zoom" off for another attempt

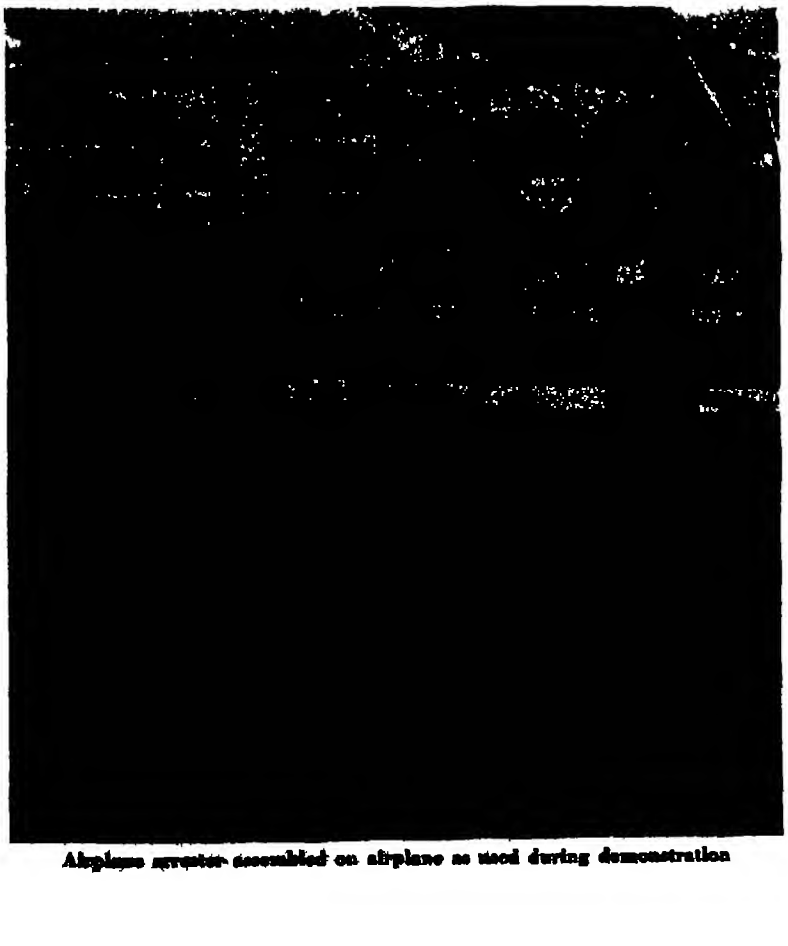
There should be a reasonable leeway within which to engage, two or three feet vertically, and ten to fifteen feet laterally being considered sufficient.

The gear should permit engagement at a moderately high speed, since to land at the slowest possible speed means to lose aileron control, and to make the effect of gusts much more disturbing.

The apparatus which Pratt finally worked out and which has stood service tests successfully on the aircraft carrier *Langley* is simple, yet meets these requirements fully

It consists of a cable or chain, or a series of cables or chains, stretched as usual parallel to the landing surfaces and at right angles to the path of flight The ends of the cables are each connected to a braking appliance The apparatus on the airplane consists of a pole, pivoted at one end to the airplane and carrying a hook at the free end The hook is connected to the fuselage at some point well to the rear of the center of gravity of the airplane, and some means is provided for raising and lowering the pole

On making a landing the pilot lowers the pole before he approaches the landing surface, so that the end of the pole carrying the hook protects a short distance below the wheels of his plane He flies over the stretched cable at such an elevation that the wheels of the plane are within three to four feet of the landing surface The chain or cable is struck by the pole and guided into the hook The connection which is now established between the airplane and the braking or retarding appliance allows the application of a relatively large retarding force to the airplane and brings it to rest in a short distance The line of force passes from the center of gravity to the point of attachment in the rear, so that all tendency to nose over is eliminated no matter how violent the braking force applied The solution is good engineering practice and well worked out



Airplane arrester assembled on airplane as used during demonstration

IN THE EDITOR'S MAIL

Worms That Turn

In the June issue, page 418, we reproduced a striking photograph of the curved designs traced on the inside of the bark of a tree by the boring of worms These designs were extremely artistic In reply to this note we have received the following comment, from a government insect scientist

Editor, Scientific American

I was very much interested in the note "In the Editor's Mail" found in the June, 1926, issue of the Scientific American entitled "Must We Cease Using Them for Bait?" and signed by Mr Paul E. Denton The photograph indicates that the larva making the galleries is one of the barkbeetles and from the appearance of the work I believe that the insect responsible is the hickory barkbeetle (*Scolytus quadrispinosus* Say) It is of course possible that the work is that of another species and on a different host tree, material alone being the basis for a positive determination

Many of the barkbeetles attack living trees and by mining between the bark and wood kill the infested tree Different groups of these barkbeetles also produce different types of galleries Frequently the patterns traced are artistic and have design possibilities.

Very truly yours
William Middleton,
Assistant Entomologist, U S Dept. of Agriculture, Bureau of Entomology

We Are Being Broadcast in Australia

From Australia comes the news that our articles are being broadcast by an enthusiastic reader Of course we are not at all surprised at the subsequent demand for copies of the magazine (ahem!) In addition to his radio activities, Mr Reed is going to build a telescope and has ordered a book to tell him how The book is on its way, and we predict a "thrill that comes once in a lifetime" when our reader gets a close-up of the heavens through his own handiwork.

Editor Scientific American

The most interesting and instructive article in the February issue of the Scientific American by Mr Russell W Porter on "Mirror Making for Reflecting Telescopes" has filled me with the desire to try my skill in this direction, having been interested in astronomy since my school days back in 1910 Enclosed please find money order for two dollars to cover the cost of the book he suggests, *The Amateur's Telescope* by Ellison

Under separate cover I am forwarding letters to the Bureau of Standards for the Letter Circular LC32 on the Silvering of Glass, and also one to Mr John Pierce of Springfield to obtain his estimate of the total cost of the materials and the express charges on them for shipment to me in Australia

I am in the capital city of our northern state attending to the installation of a five-kilowatt broadcasting station for the Queensland Government Radio Service. During the preliminary tests last week I read many articles from the January and the February issues of the Scientific American before the microphone, and as a result local news-agents inform me that they have been flooded by inquiries for copies and that several have placed standing orders for the magazine The articles on "The Movement of the Continents," and "Soil Analysis in North Carolina" were greatly appreciated by the different sections of the local University

If we can arrange it before I leave for the south we are going to try and put across a program for the listeners on the Pacific Coast Our normal night transmission from 8 P M to 10 P M will coincide with 2 A M to 4 A M in California allowing an ideal condition for long-distance transmission Our wave-length is 385 meters (780 kilocycles)

Joseph G Reed
Sydney, Australia.

Anent "Old Ironsides"

As we expected, our article about "Old Ironsides" awakened a response in many patriotic hearts. Edwin B. Eddy, Jr suggests that the old frigate be relieved of some of the enormous weight she is carrying Reader, we are with you! If we had fought so gallantly, we'd appreciate any efforts to alleviate a burden of 68,100 pounds!

Editor,
Scientific American

I was pleased to note in the July edition of your magazine the excellent article on the frigate *Constitution*. I have been aboard the vessel twice, and have been very sorry to see the deterioration of this monument to a noble past. If the Government decides to keep the *Constitution*, there is one item for her preservation that I feel ought to be called to your attention and that of the public. That is that her spar-deck battery is both inaccurate from an historical standpoint, and weakening to the ship Her armament on the gun deck is correct, but she is undoubtedly being bogged by the continuous and unnecessary pressure of twenty four long 24's on her spar-deck. She never carried—no frigate of that period ever carried—such a battery upon her quarter-deck and forecastle.

In her battle with the *Guerriere*, August 19, 1812, which may be considered her best action, the *Constitution* mounted the following guns gun deck, thirty long 24-pounders, quarter deck and forecastle, two long 24-pounders, one long 18-pounder, and twenty-two 32-pounder carronades. When it is considered that a long 24 weighs approximately 4,500 or 5,000 pounds, and that a 32-pounder carronade, only 1,700 pounds, think what a weight would be removed from this ancient vessel, if her twenty-two superfluous 24's were replaced by 32-pounder carronades in replica. With this removal, and the bringing aboard of a long 18 for the sake of adhering to history, the vessel would be relieved of from 57,100 to 68,100 pounds.

The *Constitution* received her 32-pounder carronades after the Tripolitan War, in which her spar-deck batteries, consisting mostly of 42-pounder carronades, were found too heavy for the hull. As a 42-pounder carronade is a compar-

atively small and light gun compared to the heavy long-guns she now carries on her spar-deck, what must be the destructive effect upon her, from her upper batteries? This situation seems to have been overlooked, and I respectfully call it to your attention.

Yours truly,
Edwin B. Eddy, Jr.,
Duluth, Minnesota

The Pink Turtlehead is Rediscovered in Virginia

This flower is apparently familiar to a number of our readers who have written us saying where it could be found. As lack of space does not permit our publishing all of these letters, we are using the one which reached us first:

Editor of the Scientific American.

Dear Sir:

In reference to the article in the last Scientific American on the pink turtlehead.

I have seen this plant blooming on the banks of a small stream that flows into the Tuckahoe creek in Henrico County, Virginia. The stream is about eight miles west of Richmond. It is south of the River Road. I think I saw the turtlehead blooming there last summer.

The plant that I know as the turtlehead was identified, several years ago, by reference to Dana's "How to Know the Wild Flowers," page 100, fourth edition, 1893.

Hoping that this information will be of interest to you

I am yours truly,
A P Wickham,
Woodside, Lorraine, Virginia.

A Man's-Size Egg

We have heard of Two-in-One Shoe Polish and Three-in-One Oil, but this is the first time that a two-in-one egg has been called to our attention. A Rhode Island pullet in the State of Ohio is responsible for this, according to the following communication

Editor Scientific American:

I am sending you a photograph made from an X ray of a freak and abnormal hen's egg. This egg was laid by a nine-month Rhode Island pullet The egg weighs exactly four and one-half ounces. The exact measurements are four and a half inches in length, five and three-quarters inches in diameter and nine and three-quarters inches around in length. The large egg, as you will note from the X ray photograph, has within it another egg, perfectly formed, including a complete shell

The large egg was boiled until hard and when cut in half was found to be exactly as shown in the photograph The inner egg had a hard shell and

This illustration shows the unusual size of this two-in-one hen's egg

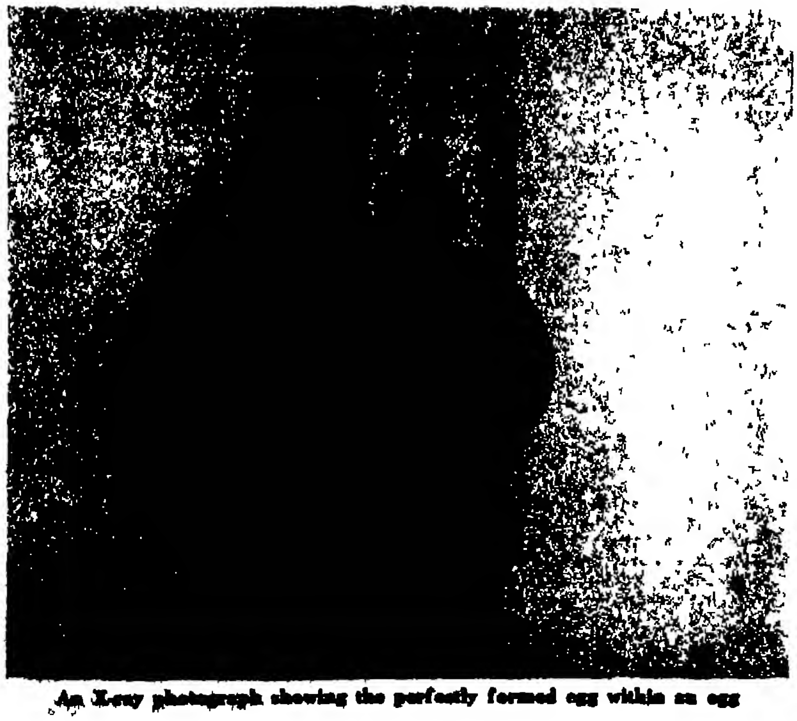
looked in every respect like any ordinary egg, containing yolk and albumen The space between the inner egg and the shell of the large egg was also filled with albumen and contained a yolk in one end.

A J Brust
Kent Ohio

Transmutation of Gold Into Quicksilver, a New Method of Attack

A new way to effect a transmutation has been tried by Dr A. Guschler, of Berlin He shoots hydrogen particles into the nucleus of the gold atom. This method ought logically to produce quicksilver (mercury) and according to Dr. Guschler, mercury was obtained Those who demand rigorous standards of laboratory work will doubtless remain partly unconvinced about the results claimed owing to the fact that a mercury vapor pump was used It is stated that this was employed only at first, and doubtless extreme precautions were taken against the accidental *contamination of the results by mercury* from the pump Can this be absolutely guaranteed? Doubt will probably exist in the minds of many until other methods are devised In the following letter Dr Guschler describes his work.

By the experiments of Miethe, Nagaoka, and the author of this subject it has been sufficiently demonstrated that it is possible, under certain conditions, to transform quicksilver into gold by electro-thermal treatment Soddy and others suggested that this might be accounted



An X-ray photograph showing the perfectly formed egg within an egg

for on the assumption that the isotope of quicksilver of atomic weight 197 absorbs an electron and thereby turns it to gold. This assumption has been refuted by an article by Aston in *Nature*, according to which it has been found that there is no isotope of quicksilver existing below *198*. A determination of the atomic weight of an atom of artificially produced gold by Hönigschmid gave a weight of 197.26.

Therefore the gold could, under no circumstances, be obtained by the absorption of an electron by a quicksilver center, so that there remains only the possibility that quicksilver turns into gold by the elimination of a hydrogen center *Vice-versa*, gold receiving a hydrogen center must be transformed into quicksilver

As it has been impossible to observe with certainty up to date the presence of hydrogen when producing gold from quicksilver, it was undertaken by the author to study experimentally the influence of hydrogen on gold, in the hope of producing quicksilver from gold and hydrogen At present the literature gives no information as to what extent a hydrogen particle or nucleus might penetrate into other atoms, especially greater ones. It can be assumed that the hydrogen nucleus, because of its extremely small size, can easily penetrate into the spaces between the electrons of an atom when possessing sufficient kinetic energy If it proceeds through the outer electron rings and is stopped by the repulsion of the nucleus, it cannot return to the surface of the atom in consequence of being bound by the inner electrons. The result is the contrary of the well known hydrogen connections (for example HCl), that is an inner connection of hydrogen which is perhaps identical with a transformation of the atom, with the hydrogen nucleus bound in the interior of the other atom presenting a para nucleus, as was confirmed with regard to quicksilver by many authors, especially by Nagaoka With this in mind the experiments of the author aimed at shooting hydrogen particles into gold atoms and determining the eventual modifications of the gold either chemically or physically

Hydrogen particles with great kinetic energy are best produced with a canal ray tube provided with palladium-osmium regeneration In my experiments I used a glass tube about 50 centimeters in length and 4 centimeters inside diameter containing a pin anode, a flat sieve cathode of aluminum in the channel at 3 centimeters distance from the latter and a plate of fine gold held in place by insulators attached to the glass tube

After the inner equipment had been glowed out well, the evacuation was carried out by disconnecting the mercury vapor diffusion pump in order to avoid contaminating the tube with quicksilver The air, having been replaced by hydrogen, the evacuation was continued by means of an oil pump, until there appeared green fluorescence in the glass on the passage of an electric current.

Several photographs of the spectrum of the tube taken at the beginning of the trials showed a great many lines, especially of aluminum and hydrogen. But no quicksilver lines appeared After 30 hours of running, the quicksilver lines could be seen distinctly in the spectrum with an intensity increasing in proportion to the duration of the experiment. Especially could there be seen with certainty lines 6152, 5461, 5670, and 4487 On repeating the experiment the result was the same

After the preceding statement there is no doubt that quicksilver represents a gold hydrogen, in which the hydrogen nucleus is bound by inner electrons. A similar connection seems to be quicksilver helium, which according to a communication by J J Manley (*Nature*, volume 114 page 861, 1924; volume 115 page 337, 1925) is likewise to be obtained by a glow discharge From this new angle the transformation of quicksilver into gold by means of the discharge of electric current is easily comprehended. By intense activity of the quicksilver atom an overload of positive electricity is produced, which is equal to the loosely held hydrogen nucleus. This is then expelled from the atom of quicksilver.

If the labors are pursued intensely on this basis, chemistry will soon be enriched by a great number of inner hydrogen and helium associations to which group quicksilver and others may be found at a later date to belong.

The author of this report would see the most favorable aspects for his work if an American institute would procure for him the opportunity to pursue his experiments under better conditions in the United States.

Dr Gaschler,
Berlin, Germany.

Poetry in Science

The father of one of our youthful readers believes that the Scientific American has helped to develop in his son a research trend of mind, and that the piece of blank verse which we are very glad to publish herewith was written as a result of his having pored over our columns. We are glad to know that our young subscriber has found in science the beauty which escapes the eyes of many

Editor, Scientific American.

My son, Bryant Chester, nearly eighteen, has been a subscriber to the Scientific American for several years, during which time he has developed a research trend of mind along electron lines. In his English work at school he is required to write something original each week in prose or verse He has just turned out a piece of blank verse of which I am naturally proud

I am sending the attached copy to you as, no doubt, this reflects the influence of his reading your publication. It is also interesting to note that he has caught something of the spirit of his distant cousin, William Cullen Bryant.

M. E. Chester

EXCURSIONS OF THE MIND

If man could but conceive himself to be,
Far smaller than the smallest speck of dust,
And further, still reduce himself in size,
Until that speck of dust seemed greater than
This very world that travels round the sun,
What then might be revealed before his eyes?
All substance, as we see it now would fade,
And change to fast and geometric shadows.
A weird and restless light would dominate
And fill all space, and silence would prevail
So, from his tiny perch, man then could watch,
And marvel at the strangeness of his world,
And see and feel with an unaided eye
The mighty laws and forces of the atom.
As are the stars held in their given course,
Whirling through the boundless paths of space,
So are the smallest rudiments of matter,
Held to their place by laws inflexible
Yet, all this may not be a wildest dream.
Composed of fancies and disordered thoughts,
Man never knows what lies in wait beyond,
Until his mind has sought and found it first.

Bryant Chester

A Pardonable Slip

As there is such a close association between "sweetness" and "fragrance," it is not surprising that Mr Miyake substituted one for the other in his microscopic reproduction of the verse from Gray's "Elegy" We are just naturally curious, though, to know how many readers noticed it It did not get by the eagle eye of Mr. Phillips, who sends the following note.

Editor Scientific American

On page 331, May issue of your magazine, Mr Miyake has done some fine work in reducing a verse from Gray's "Elegy," but he made a mistake on the last line. "Sweetness" does not travel on the air. "Fragrance" is the original word.

J. N. Phillips.

Science and Money

Investment Trusts

By Henry C. Trundle

KNOWN for many years to British and Scottish investors as a premier investment, the securities of investment trusts are just beginning to gain recognition in this country where their organization dates only from post war days. The original trusts were formed in Europe to take advantage of the opportunities for higher return from enterprises in North and South America in the early days of nation building. Oddly enough, situations are now so reversed that trusts are being organized here to profit from the investment bargains obtainable in European markets. Both then and now these trusts have been important factors in the economic maintenance of countries and have proven highly satisfactory for investment purposes as well. Some of the larger European investment trusts own as many as four and five hundred individual securities and our own trusts are also approaching this size and distribution. As the securities held are of companies operating in all parts of the world and engaged in multiple lines of business it is to be readily seen that an investment trust is but an agency by which funds can be invested with wide diversification and with excellent probabilities of high yield. A trust virtually places the small investor, from the standpoint of safety, on the same footing as the wealthy investor who is enabled to distribute his funds over a wide area, for he shares in the whole accomplishment rather than risks his all on one or two ventures. Besides the ability to do more through the concentration of money, there are psychological and other reasons why the average individual would fare better through an investment trust than alone.

Organized for the purpose of investing for income, investment trusts ordinarily secure their capital through the issuance of stock, common and preferred. When conditions seem advisable, additional capital is obtained for short periods by the sale of bonds or from bank loans, with the effect that the earnings per dollar of contributed capital are materially increased. A properly managed trust also will have its capital added to through the retention of a part of the profits in a surplus or reserve fund. Because of their large purchasing capacity, trusts frequently occupy a position in new offerings equivalent to that of the underwriters. This enables them to acquire securities several points under the quoted offering price and permits of an increased profit when and as these securities can be resold to the public. As many offerings are bid up quickly and remain at their new higher prices, this source of profit is an appreciable one.

One of the chief reasons why the small investor suffers so many losses due to acts of omission or commission is that he becomes wedded to his securities and nothing can lead him to make a switch. This is not true of the management of an investment trust which relies on trained staffs of analytical experts for advice. Accordingly, when it is deemed advisable, all long term securities are replaced by short term securities, or exchanges are made among individual issues. Whether it be because of statistics or fashion, everything is done to assure the greatest profit.

"Inside Information"

As the Board of Management of a large trust is likely to contain men who are high executives in corporations, the trust can have the benefit of inside information of coming events. Sales or purchases can thus be undertaken with full confidence and at the very time when such transactions would appear as ill advised to the unknowing public. Right here it might be well to interpolate that investment trusts have frequently taken up the cudgels in behalf of the minority holders in instances of reorganizations or malpractices. Furthermore, since the directors are experts in matters of investment, securities are more apt to be purchased at low points and sold at high points. It is unfortunate, but then it almost always happens so, that the public is in a buying mood only when securities have had a sizable advance and that it becomes frightened on declines and sells at the low points, just when it should be buying. The scientific management of a trust will obviate this situation for it is not disturbed by gossip and its dealings are based on real knowledge. In fact the trusts always have orders in to buy a large number of securities at prices below intrinsic values and to sell at prices above such values. The natural swings of the market make it possible to have many orders executed each day. The trust therefore profits where the ordinary investor would in all likelihood be getting caught on the wrong side of the swings.

Trusts Always Alert

The international character of the larger trusts brings them into contact with all of the major security markets of the world, and affords them opportunities to profit by temporary depressions as they occur from time to time. For instance, in the bear raids in March, the European trusts undoubtedly picked up many shares of stock which in the mêlée were driven far below their actual values. During the subsequent recovery these shares were probably resold at a nice profit. When market conditions are stable here, some break might occur in London or Buenos Aires, affording our own trusts a similar privilege of acquiring stock at bargain prices. Curiously enough, too, the identical securities will sell at different prices at the same time on the various exchanges. As an example, we mention that the German Government bonds were selling in London at above 100 when they were quoted in New York at around 96. There was such a difference of several points for a number of other securities which had been offered simultaneously in Europe and America. This situation enables a trust to purchase at the cheaper price in one market and to sell at the higher in the other. Transactions in these securities can be carried on without any appreciable risk until such time as the prices shall have become equalized. The chances are that an individual would either not know of this situation, or knowing it, would not have the necessary capital or contacts to profit thereby.

As yet, mention has only been made of the large number and diversified character of the securities in the investment trust strong box. Since these trusts are regarded as scientifically managed, many persons are particularly interested in knowing just what are the actual holdings. Such a list can not be published because of the influence this information would have upon the security market, especially as the trusts own ability to buy and sell freely would be cramped. However, the trusts frequently make known the types of securities they are interested in and the geographical location of the companies. Of course, where a trust is formed specifically to hold railroad, public utility, bank or some other distinct class of security, the management is likely to be more liberal as to the details.

Persons who incline toward bonds over stocks, or vice versa, will be interested to know just what the practice is with respect to holdings in senior and junior securities. Earlier in the year one of our own trusts

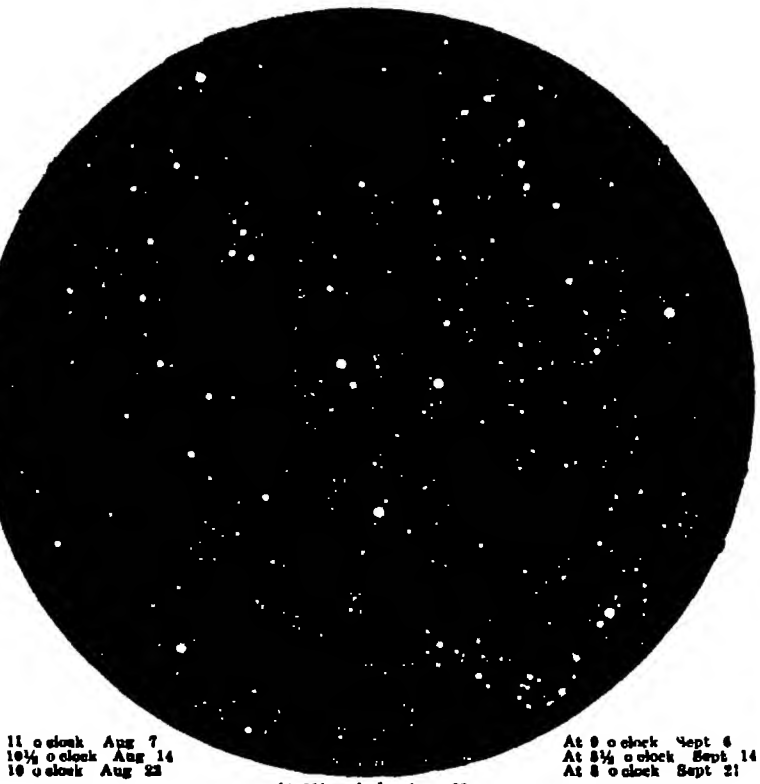
made known that of its funds 74 percent were in bonds, 22 percent in preferred stocks and bank shares and 4 percent in common stocks The British trusts tend more toward common shares, some trusts having as much as 40 percent of their capital in them It is not unlikely that American trusts will extend themselves in this direction as profits become smaller from domestic and foreign senior securities

The American investor interested in investment trust securities will probably only want those of our own trusts which are purchasable for the most part not on the exchanges but "over the counter" from banking concerns Trading in these securities is fairly active and close markets are maintained so that liquidation of holdings can be accomplished satisfactorily at any time A choice is offered of two main types (1) the stocks or bonds of a trust or (2) the participating certificates or beneficiary shares in a fund From a market standpoint the first type is the most desirable, and is the type to which we have referred

Granted that diversification and good management will assure a safe investment it will be well to inquire into the liberalness of dividend and interest payments Naturally the bonds of a trust will carry a fixed rate of interest and will sell at prices in direct relation to the cost of money just as does any corporation or government bond The preferred stock will also vary but little in price and will sell on practically an investment basis The common shares however are the ones to which to look for large returns and shifting prices Efficiency of management and rapid turnover of money will be reflected in the balances left for distribution to the common The long record of large dividend payments made to the common share holders in British and Scottish investment trusts shows that they are quite liberal Certainly rates of around 10 percent can be considered as a satisfactory inducement

The Heavens in August

By Professor Henry Norris Russell, Ph D



At 11 o clock Aug 7
At 10½ o clock Aug 14
At 10 o clock Aug 22
At 9½ o clock Aug 29
At 9 o clock Sept 6
At 8½ o clock Sept 14
At 8 o clock Sept 21

The hours given are in Standard Time When local summer time is in effect, they must be made one hour later 12 o clock on August 7 etc

NIGHT SKY: AUGUST AND SEPTEMBER

The Heavens

ON our map of the heavens this month we find Cygnus right overhead—the foot of the cross being to the southwest Lyra is west of the zenith and Aquila south Scorpio and Sagittarius are low in the southwest and Bootes in the west with Hercules and Ophiuchus above Draco and Ursa Major are in the northwest and Cepheus and Cassiopeia high in the north while Perseus and Andromeda are in the northeast Pegasus is in the east and Capricornus Aquarius and Pisces Austrinus in the southeast

The Planets

Of the planets, Mercury is in conjunction with the sun on the 7th and is not visible until the latter part of the month—best about the 25th, when he is in elongation 18° from the sun and rising at 4 A M so that he can just be seen in the dawn Venus is a morning star too and rises a little after 2 A M Mars is growing brighter as he approaches opposition, and by this time he exceeds all the other stars except Sirius He is in Aries and rises at 11 P M at the beginning of the month and 9 30 at its close

Jupiter is in opposition on the 15th and is splendidly visible all night long—the chief ornament of the evening sky Saturn is in quadrature east of the sun on the 13th and is well visible as an evening star Uranus is in Pisces and crosses the meridian at 2 A M in the middle of the month while Neptune is in Leo and being in conjunction with the sun on the 18th is invisible

The moon is new at 9 A M on the 8th in her first quarter at midnight on the 16th full at 8 A M on the 23rd and in her last quarter just before midnight on the 29th She is nearest the earth on the 23rd within a few hours of full—look out for low and high tides!—and is farthest away on the 10th During the month she is in conjunction with Venus on the 5th Mercury on the 8th, Neptune on the 9th Saturn on the 16th Jupiter on the 22nd Uranus on the 25th, and Mars on the 28th

Commercial Property News

A Department of Facts and Notes of Interest to Patentees and Owners of Trademark Rights

Conducted by Milton Wright

Good Will Cannot Stand Alone

THE Bureau of Internal Revenue recently issued a decision to make its regulations conform to a ruling of the Court of Claims in holding that good will could not be separated from the tangible assets of a firm in which an interest had been purchased.

Upon the purchase of an interest in a going business the Bureau declared "good will cannot be separated from the tangible assets and considered as a gift exempt from tax under Section 4 of the Revenue Act of 1916 since the purchase of an interest in a business includes as an incident thereto an interest in the good will and the gain derived from a sale of the entire business includes a sale of good will and is measured by the difference between the cost and selling price."

The Army "Tin Hat" Case

ALTHOUGH a British subject may not sue the British Government he may sue the United States Government.

So ruled the Court of Claims recently in the action brought by John L. Brodie, Englishman and inventor of a steel helmet worn by British and American soldiers in 1918. The Brodie type of helmet was worn by American soldiers in 1918. Many complaints were made about it however and finally the General Staff ordered the A. E. F. equipped with the Liberty Bell helmet which had been developed by Major McNary.

On January 1, 1918, a United States patent had been issued to Brodie. On October 3, 1919, he presented the War Department with a claim for $2,000,000 and asked for a check.

"It is conceded in argument," Judge Downey says in writing the opinion of the court, "that United States citizens have the same standing in British courts as do British subjects but contended that neither could or can prosecute an action for tortious infringement against the Crown. . . . The true test is not whether a citizen of the United States may prosecute an action of a particular nature in a British court but whether the doors of British courts are open to American citizens for the prosecution of claims against the Crown but necessarily only such claims as might be prosecuted by British subjects for there as here there are classes of action as to which the Sovereign has not consented to be sued. We think the plaintiff has standing in this court."

The court ruled however that in the light of the prior art there was no patentable novelty or invention in Brodie's helmet and that the patent which had been granted to him therefore was invalid. His petition was dismissed.

"Direct" Through the Middleman

THE Federal Trade Commission a short time ago looked into the Factory To You Furniture Store in Philadelphia operated by M. Goldberg and found that the public has been laboring under the impression that the proprietor owned and operated a factory and gave his customers the benefit of profits which otherwise would go to the wholesaler, jobber and retailer.

They found too that the furniture was called "walnut," "genuine walnut," "combination walnut," "mahogany" and "combination mahogany." The names however constituted almost the only place they could find walnut and mahogany. Wherefore they issued the necessary orders to discontinue false and misleading advertising.

The moral of which is: do not believe all you read in the store window.

Patents Recently Issued

Classified Advertising

Advertisements in this section listed under proper classifications, rate 25c per word each insertion, minimum number of words per insertion 24, maximum 60. Payments must accompany each insertion.

Official copies of any patents listed in this section at 15c each, state patent number to insure receipt of desired patent copy.

Pertaining to Aeronautics

SEMIRIGID DIRIGIBLE—Advanced lifting means of aeroplanes combined with lifting gases helium in lower hydrogen in upper part of gas bag wherein pressure is regulated at will of operator. No ballonets, valving or ballast necessary nor outside help by alighting on land or water. Two patents 1401598 and 1522761, 63 claims. Canadian patent 247713. John Twardus, 107 Seymour St., Hartford, Conn.

AEROPLANE—Having a special construction of surfaces controllable at will for effecting the lifting power and varying the positions of the machine. Patent 1570198. C. W. Newson, 638 W. 3, North St., Salt Lake City, Utah.

AIRSHIP—Wherein the motors for driving the propellers are so mounted and controllable that they may be drawn adjacent the cabin for repairs or other purposes. Patent 1580004. A. Bradford, 1181 Kerby St., Portland, Oregon.

SAFETY ATTACHMENT FOR AIRPLANES—For the purpose of materially increasing the displacement and retarding descent, thus preventing serious danger to the plane and its occupants. Patent 1583745. V. J. M. Procopio, 98 Grove St., New York, N. Y.

Pertaining to Apparel

CORSET—Which may be adjusted to the height and figure of the wearer without detaching any of the parts. Patent 1581002. J. J. Kasper, c/o I. Newman & Sons, 17 Oak St., New Haven, Conn.

WASHABLE GARTER—Which is adjustable and will remain substantially unaffected by the washing process as distinguished from garters having elastic portions. Patent 1581424. F. C. Bloomer, 845 W. 62d St., Kansas City, Mo.

COMBINED SANITARY SHIELD AND RECEPTOR—A bifurcated garment for women adapted to encircle the hips and upper leg portions of the body. Patent 1580464. Frances H. Blumenfeld, 2011 Macdonald Ave., Richmond, Cal.

HAT—Having greater flexibility in the portion fitting about the head whereby it will shape itself to the head and prevent binding. Patent 1582812. S. Ivan, c/o L. P. Heid & Co., 11 W. 19th St., New York, N. Y.

GARMENT—A sleeping garment by the use of which certain parts of the body of the wearer can be kept cooled. Patent 1582385. H. C. Dauphinais, 2020 Front St., Fargo, N. D.

Chemical Processes

PROCESS OF MAKING COMPRESSED YEAST—From molasses or other carbohydrate products by means of which the bacteria originally contained in the mashing materials are preserved. Patent 1580500. R. Kusserow, 6861 Fern St., Oakland, Cal.

PROCESS FOR PREPARING VACCINES—Which comprises treating capsulated bacteria and bacterial toxic proteins with alkali to break the capsules and then digesting with trypsin. Patent 1584583. F. M. Wood, 1720 W. 54th St., Los Angeles, Calif.

Electrical Devices

POLE FOR CARRYING ELECTRIC CABLES, TELEGRAPH AND TELEPHONE WIRES AND OTHER PURPOSES—Consisting essentially of two flanged beams of rolled steel spaced some what apart and held together by means of tie bolts. Patent 1579965. J. C. Stokie, c/o Collison & Co., 483 Collins St., Melbourne, Australia.

ELECTRICAL SIGNALING DEVICE—Whereby the condition of an electrical circuit may be indicated at a remote point. Patent 1580313. M. W. McIntire, 5 Dock St., Wilmington, N. C.

BRAKE OPERATING MECHANISM FOR ELECTRIC HOISTS AND THE LIKE—More particularly a device for the purpose of regulating the speed at which the brakes are applied. Patent 1579549. H. H. Logan, c/o Duro Metal Products Co., 2649 N. Kildare Ave., Chicago, Ill.

ELECTRIC CONTACT BREAKER—Of the flat spring type which is so damped as to enable it successfully to operate at high speed. Patent 1581186. A. J. H. Dierson, The Lynch, Clifton Rd., Wimbledon, London, S. W., England.

RADIO INDUCTANCE COIL—Whereby the wires may be wound in a compact cylinder without any necessity for using insulated wire. Patent 1581067. O. G. Lissen, 151 Highland Ave., Jersey City, N. J.

ELECTRICAL CONNECTER—Whereby a circuit wire may be simply but very securely fastened within the connecter and will stand great strains. Patent 1583897. A. F. Latham, 52 Lincoln Place, Brooklyn, N. Y.

CORD HOLDER AND GUIDE—For electric flat irons, and means whereby a slack loop may be maintained permitting freedom of movement for the iron. Patent 1584500. J. D. Archard, 5005 Grand Central Terminal, New York, N. Y.

TRAIN OPERATED ELECTRIC SWITCH—The operating mechanism being adapted to be actuated by the flange of a car wheel on the track rail. Patent 1585178. J. K. West, Detroit, Minnesota.

ELECTRIC SIGN—Having a thoroughly automatic mechanism for handling an endless perforated tape and controlling the supply of current of the illuminating lamps. Patent 1580436. P. Z. Barrundia, c/o H. Triest & Co., 35 So. William St., New York, N. Y.

PROCESS FOR THE INSULATION OF ACCUMULATOR PLATES OF DIFFERENT POLARITIES—Consisting in applying thin sheets of wood to the sides of the plate and a frame of ebonite to the edges in overlapping engagement. Patent 1586406. L. Caillard, c/o Office Picard, 97 Rue St. Lazare, Paris, France.

SIGN—Which is illuminated at both sides by a single or series of electric bulbs located in openings in the sign. Patent 1586464. R. M. Pearson and W. Letzig, 310 Spring St., Little Rock, Ark.

Of Interest to Farmers

AUTOMATIC RELEASE COUPLING—For use in agricultural pursuits between a tractor and a plow automatically releasing the plow on abnormal resistance. Patent 1581467. W. A. Mueller, 810 No. Penn St., Aberdeen, S. D.

HARVESTING MACHINE—For harvesting maize or corn, its main object being to remove the cobs or ears from the stalks while in growing position. Patent 1583751. P. T. Woodland, "Ormsdale," Florida Road, Durban, Natal, South Africa.

WATERPROOFING COMPOSITION FOR GLOVES—Which when applied to the hands or fabric gloves will protect them from injury during the husking or harvesting of corn. Patent 1583493. F. M. Reed and C. Paulsen, c/o C. P. Anderbery, Minden, Neb.

"Stainless Steel" Name Is Public

ANY cutlery manufacturer may stamp his rust and stain resisting articles "Stainless Steel," according to a decision recently handed down by the Patent Commissioner. This decision represents a victory of several manufacturers of steel products over the American Stainless Steel Company, which heretofore has claimed a monopoly in the use of the term.

The case arose when the American Stainless Steel Company applied for registration of Stainless Steel as a trademark. A number of companies protested. Among these was the Camillus Cutlery Company. In the testimony it developed that the American Stainless Steel Company neither makes nor sells steel articles of any kind but merely holds patent rights which it leases to various manufacturers.

The Patent Commissioner based his decision on the fact that the term "Stainless Steel" is one of long standing and wide use as well as on the fact that the term is purely descriptive.

New Chinese Copyright Law

THE Republic of China recently adopted a new copyright law. Apparently the law has escaped the attention of the various foreign powers in China and was not submitted to them for any criticism or approval as they yet have little or no knowledge of the new law. No specific restriction against foreigners appears in it.

Following are some of the provisions:

"An author is entitled to copyright privileges during his lifetime. In case of death such copyright passes to his heirs for a term of thirty years.

"The legal heirs of a deceased author shall be entitled to copyright for a term of thirty years on the publication of the posthumous work of the author.

"Copyright of photographs shall be granted for a term of ten years.

"If within the term of copyright, revision alteration of the text or insertion of illustrations is made, specimens must be presented at the office where the work was originally registered.

Anyone who pirates or plagiarizes a copyright work is liable to a fine of from $50 to $500. In addition damages may be collected by the person injured.

"Making a false statement in an application for a copyright is punishable by a fine of from $20 to $200 in addition to having his copyright cancelled.

"Where authors have been fined according to this law their literary works shall be confiscated."

Translating Trademarks

WHEN Charles E. Culpepper, of New York, recently sought to register the word "Como" as a trademark for non-alcoholic beverages the Howdy Company, beverage manufacturers of St. Louis, objected, urging that "Como" was an infringement of their trade mark "Howdy." The resemblance was not at all clear until the opposer explained that como is the Spanish equivalent of howdy. Fortunately for Culpepper, there was another factor in the case.

"It may be deemed settled," said Acting Patent Commissioner Kinnan, "that a rival in trade cannot be permitted to translate a trademark used by another into a foreign language and obtain registration for it when used upon the same class of goods. In view of the evidence supporting the claim of the applicant of prior adoption and use, it is unnecessary to decide the question of whether the applicant has done more than translate the opposer's mark into the Spanish language."

POTATO GATHERER.—Which may be attached to any conventional form of potato digger for separating the earth from the potatoes. Patent 1581099. W C. Roth, R. F D. No. 35, Randall Rd., Le Roy, N Y

Of General Interest

IMPROVED PASTE TUBE CAP.—Adapted to collapsible paste tubes, easily operated for allowing the discharge or cut-off of the paste and possesses positive non losable features. Patent 1570238. J R. Gibson, 38 S Dearborn St., Chicago, Ill.

BLOTTER ATTACHMENT FOR PEN STAFFS.—Which can be readily applied to a pen staff and will not prevent the placing of the pen in the pocket. Patent 1579465. D Brittain, Box 248, Galesburg, Ill.

BATH BRUSH.—Applicable to any conventional tub and adjustable to any desired position, so that it will contact with a person's back. Patent 1577565. V F Creegan, 743 So. Beacon St., Los Angeles, Cal

COLLAPSIBLE-TUBE CLOSURE.—Whereby a screw threaded cap, constituting a closure, is limited in its movement and prevented from accidental loss. Patent 1580060 H L Morean, c/o E. A. Derby, 123 Waverly Place, New York, N Y

NECKLACE CLASP.—Constructed by a single stamping so that when bent it will form a front and rear without employing solder or rivets. Patent 1579083. F B Wendel, c/o Hercules Novelty Mfg Co, 126 South St., Newark, N J

SAFETY RAZOR.—Having three cutting edges, with means for permitting the user to keep track of the edges fresh for use Patent 1579459. W. F von Hammerstein, 4500 Melrose Ave, Los Angeles, Cal

DIVING BOARD.—Designed to give a high degree of resiliency without undue strain to the portion above the fulcrum Patent 1578510 W S Brown, Room 201, Men's Gym, Urbana, Ill

CLOSURE FOR TANKS.—Which may be applied and removed from the exterior of an oil tank without necessitating the workman entering the tank. Patent 1580229 A Boynton, 1019 City National Bank Bldg, San Antonio, Texas.

FUEL ECONOMIZER.—In the form of a preheating arrangement adapted to be employed in conjunction with furnaces Patent 1580383. J F Schlappi, 2300 Pierce St., Sioux City, Iowa.

ADVERTISING DEVICE.—In the form of a fish to be floated on or below the surface of liquid, with a suitable advertisement visible Patent 1580227 D C Wilhelm, Gillette, Wyoming

PASTE DISPENSING DEVICE.—For dispensing tooth paste, cream or the like without exposing any except that dispensed, and permitting any quantity dispensed Patent 1581074. T M Macfarland, 53 Park Place, New York, N Y

MOLD.—Which can be associated readily with a plurality of similar elements from which the molded articles can be quickly removed Patent 1581043. G Ey, 307 E. 87th St., New York, N Y

ANIMAL TRAP.—Strong and durable, may be easily and quickly set and adjusted, and is humane in its action Patent 1580583 W. Catlin, 308 E Park St. Rockville, Ind.

METHOD OF MAKING TYPEWRITER RIBBONS.—Having end portions which are free from ink so that the operator can readily manipulate the same without soiling the fingers. Patent 1581040 H B. Vannote, c/o H. M. Storms & Co, 516 Grand Ave., Brooklyn, N. Y.

TOOTHBRUSH RACK.—Including means for rigidly supporting the same from under a molding or for gripping the edge of a glass shelf. Patent 1581083. G J Snyder, 335 Ogden Ave., Jersey City, N J

METHOD OF PRESENTING AN ANIMATED PICTURE PUZZLE.—The purpose being to exercise the wits of an audience as well as to provide a feature of entertainment. Patent 1581026. L Schwartz, c/o Schwartz Enterprises, Inc., 111 Westchester Sq. New York, N. Y

FOUNTAIN PEN.—Held within a casing, which is automatically withdrawn or closed with the movements of the pen Patent 1580987. J C. Alford, Maben, Miss.

ARTIFICIAL SHINGLE.—Formed of finely ground rock asphalt and Portland cement pressed to the desired thickness, readily handled without breaking. Patent 1581308. S. R. Christy, O M. Long and F. R. Brents, c/o Christy & Huggins Co., Louisville, Ky.

CORNER-BLOCK MOLD.—For use in making concrete corner blocks, so constructed that the deposits of concrete will not result in disalinement of the blocks. Patent 1581044. G Ey, 307 E. 87th St., New York, N Y

FISH GIG.—Which may be readily disassociated from its pole without loss of the gig and easily taken from the fish Patent 1581821. F E Raithel, 1119 E Miller St., Jefferson City, Mo

WATCH STAND.—Whereby a watch may be supported and the face illuminated, that the hands may be visible in a dark room. Patent 1581452. E. H. Krebbiel, Donnellson, Iowa.

FRENCH DRIP PERCOLATOR.—Which does not necessitate the constant manual pouring and repouring of the water over the coffee grounds. Patent 1581871 L S Roberts, c/o Roberts Book Store, Hamilton, Mont.

EMERGENCY CALL DEVICE.—Attachable to the exterior of a building, a door frame or the like, and contains information for making various emergency calls. Patent 1581981 W. H. Phelps, 705 8th Ave, New York, N Y

WALL PROTECTOR.—For beds or other furniture contacting with the wall or baseboard of a room Patent 1581071 F X Mautsion, Ashton and Willets Road, Homesburg, Philadelphia, Pa.

HANDBAG.—Of substantially usual construction, but having a secret compartment for carrying cosmetics and the like Patent 1581985. M Sachs, c/o Washington Leather Goods Co., 15 E. 26th St, New York, N Y

MEGAPHONE.—Especially adapted for use by college cheer leaders, although, of course adapted for other uses. Patent 1581972 T S. Mason, 66 Redding St, Hartford, Conn.

PIPE.—With hollow bowl for holding ordinary smoking tobacco, but having the form of a cigar and mouthpiece Patent 1581080 D Tabenau, No 3 Rue Saint Sauveur, Seine Department, Paris, France

EDUCATIONAL APPLIANCE.—For teaching the construction of sentences in either a native or a foreign language Patent 1581023 J H Frome, Rushland, Pa

ADAPTABLE ORNAMENT FOR DRAPERY TIE BACKS.—The ornament on the tie-back being loosely mounted so that it may be adjusted longitudinally to suit the taste Patent 1581900 M Bernhard, c/o M Bernhard & Co, 16 W 18th St., New York, N Y

SAFETY GUARD FOR EARRINGS.—Which will serve to prevent the loss of the earring through the unintentional loosening of the screw clamp. Patent 1582783 K M. Connally, 528 McCormick Bldg., Chicago, Ill.

HOLDER.—In the form of a match holder attachment adapted for use in connection with cigarette packages. Patent 1582108 O D Willis and E W Felix, 633 14th St., Huntington, W Va

FASTENER AND GUIDE FOR ASPHALT SHINGLES.—Which will act as a fastening and alining means for one or a plurality of overlapped shingles Patent 1582727 J J Bradfield, 56 Twombley Place, P O Box 86, Jamaica, N Y

DOLL.—With novel and positive means whereby the eyes may be made to close by pressure on a portion of the body Patent 1582778. G H Parsons, c/o Averill Mfg Co., Wales Ave and 143d St., Bronx, N Y

COMBINED BATHTUB AND SHOWER CLOSET.—Which in addition to constituting a means for taking a shower or tub bath, economizes in space required Patent 1582881 B N Kraemer, 420 E. 155th St., Bronx, N Y

Hardware and Tools

WRENCH.—Of the type termed spanner wrench, which may be readily shifted to take care of different sized objects. Patent 1579002. A. Altman, 739 Coster St., Bronx, N Y

BUTTING GAGE.—Which makes the chiseling of the recesses in a door, to receive butt hinges, extremely accurate and simple Patent 1577043. C. E. Woodley, 16 South Riverside, Klamath Falls, Oregon

LOCK FOR PLUGS.—Especially designed for use in connection with grease caps, and eliminates loss or displacement Patent 1580016. G S Collins, 670 N Maine St., Meadville, Pa

SCREEN FASTENER AND PROTECTOR.—For holding an extensible window screen locked in applied position in a window frame. Patent 1579445. C. M. Haddox, 6 California Apt., California Ave., Charleston, W Va.

APPARATUS FOR TEMPERING TOOLS AND THE LIKE.—Which automatically carries the tools through the tempering solutions, whereby a gradual cooling of the proper parts is accomplished. Patent 1579800. E E. Jacobs and M Karnes, West Frankfort, Ill

DETACHABLE TOOTH SECTION FOR SAW BLADES.—Whereby when the teeth become dull the section may be replaced in lieu of sharpening the teeth Patent 1581010 W J Roe, 217 Liberty St., Newburgh, N Y

CAN COVER LOCK.—Especially adapted for use on milk cans for securely holding the cover against accidental displacement, the lock being manually released Patent 1,581 000. W Hug c/o Belutker & Hug Import Co, Medford Wis

GEAR AND WHEEL PULLER.—Constructed to remove a gear or wheel by screw means from a shaft on which it is mounted Patent 1580082 W I Wooldridge, 40 Church St New York, N Y

TURNING TOOL.—Designed for turning in the ends of tubular hems used in various garments for the reception of tapes Patent 1581083 W B Rood, 7 Pleasant St, Ware, Mass.

SHADE AND CURTAIN BRACKET.—Which is adjustable and may be detachably secured to a window frame without the use of nails, screws or other fastenings Patent 1581313 A J Gannon, 34 N W 2nd Ave, Miami Fla

HYDRANT.—Readily turned on and closed automatically without jar, may be easily taken apart for repair or replacement. Patent 1581721 P C Clark, 206 So 2nd St, Montrose, Col

SAFETY RAZOR BLADE.—Wherein means is provided to positively indicate use of the blade and prevent palming off old blades for new Patent 1581068. J Llobet, Bernaza 31, Piso Alto, Habana, Cuba

DEVICE FOR TIGHTENING FLEXIBLE LINES.—Particularly designed for use in tightening guy wires used on oil well derricks, telegraph poles or the like Patent 1581104 A Boynton c/o Feather Oil Co City National Bank Bldg, San Antonio Texas

INSERTABLE JOINT.—For soil pipes and the like wherein a new section may be inserted without disturbing the lower or upper parts of the pipe and at the same time present proper support for the superimposed sections a substantially continuous pipe being provided The inventor has been granted four patents 1581755, 1581073 1581074 and 1581075 J J Meyer, 334 Lenox Ave New York, N Y

CASTER.—Which is ball bearing may be readily taken away for the purpose of replacement and quickly lubricated without detachment. Patent 1582705 C W Smith Box 712, Mexia, Texas.

TWIN PACKING NUT.—Whereby a packing operation may be carried out without requiring the closing of a valve whose leaky condition necessitates its being packed Patent 1582780. W A Rhodes, 711 Lexington Ave, Brooklyn N Y

DRILL OR CORING TOOL.—For use in earth boring easily operated to form a core cut the same off and bring it out of a well Patent 1582004 T M Conrey 2001 Monroe St, Wichita Falls, Texas

INSERTABLE SAW TOOTH AND HOLDER THEREFOR.—A holding means with resilient holding members that yield to the forcible withdrawal of the tooth by a suitable tool Patent 1583667 A M Carrier, 315 E. 3rd St Aberdeen, Wash

SWINGING DOOR STOP.—For use in maintaining garage door or the like in open position, the device being in unobstructing position when not in use Patent 1583850 E H Bobo, Box 116, 431 Bobo Ave, Ranger Texas

WRENCH.—Having a plurality of working heads of various sizes, easily connected to the operating means, yet readily shifted to inoperative position Patent 1583331 A H Alty and A E. McFarland, Wilson Okla

CLEAT FOR CONVEYER CHAINS.—Which may be easily mounted, readily renewed, and tends to lengthen the life of the chain materially Patent 1583614 D L Smith Vernonia, Oregon

CORING TOOL.—Which collects a core or sample of formation and insures its retention while the tool is being withdrawn Patent 1582036. F E. Shriver, Field Supt c/o Burmah Oil Co Badarpur Ghat, India

LUBRICATOR FOR FLUID-ACTUATED APPARATUS.—Such as hammers and drills, which permits of replenishing the supply of lubricant during the operation of the device. Patent 1582308. J W Arnold, 630 Moultrie St., San Francisco, Calif

CUTTING TOOL.—Designed for cutting circular openings and ornamental scores in hard rubber or other material, is adjustable and especially adapted for radio equipment. Patent 1584584 P A Wood, 243 Fosdick Ave, Brooklyn, N Y

BRACKET CONSTRUCTION.—Formed from sheet metal, adapted for use in any location, and easily assembled as a shelf or supporting bracket Patent 1584575. O N Waelti, 2nd Ave Seamans, Saskatchewan, Canada

DOORSTOP.—Readily applicable to a door and capable of manipulation to active or inactive positions either by hand or foot Patent 1584037 C A Neuviller 52 Garfield Ave Paterson, N J

Heating and Lighting

CLOSED HOT AIR HEATING SYSTEM.—Wherein cold air is continuously taken into the same, heated and delivered in a heated condition to the rooms. Patent 1570230 T. F Meinhardt, G I Ray and G G Ray, Box 1318, Charlotte, N C

PORTABLE OIL BURNER AND TORCH.—Which will act as a flare for night workers or as a snow melter for railroad switches or the like Patent 1581078 J Mulroy, 260 Princeton Ave, Jersey City, N J

WATER HEATER.—Wherein the heating coil is positioned with its ends embedded in a surrounding casing so as to eliminate leaking by expansion and contraction Patent 1581020 C Dargent, 400 Crescent St, Brooklyn, N Y

HOT AIR FURNACE.—Particularly well adapted for use with crude oil burners and the like, and which uniformly distributes the air to be heated Patent 1585080 L. W Hamilton, 275 Valentine St Kenosha Wis.

GUARD.—And protecting means, for association with heat conduits, which will be insulated from direct contact yet will permit radiation of the heat Patent 1586422 A W Furnivall 127 Remsen St Brooklyn, N Y

BURNER.—In which a combustible mixture of water and oil providing an intense flame may be projected a short or long distance Patent 1586054 C W Turner New York, N Y

Machines and Mechanical Devices

MACHINE FOR TRUING ENGINE CRANK PINS OR SHAFT END BEARINGS.—A relatively small hand-operated machine readily attached to the end of the crank pin to be trued Patent 1579246 M Redmond, 7312 Detroit Ave, Cleveland, Ohio

GATE.—Having mechanism adapted to be operated by a vehicle approaching to effect the automatic opening of the gate Patent 1578705 J H Bard, 100 So Heliotrope Ave Bell, Cal

MINING MACHINE.—For facilitating various cutting operations, such as drift mining, open cut excavating, loading road building, etc Patent 1579704 H L. Grow, 302½ Sangrando Rd, Los Angeles, Cal

APPARATUS FOR PRODUCING STEREOSCOPIC MOVING PICTURES.—With the result to the eye of a rounded effect, as though one were looking through a window, instead of upon a screen Patent 1579974 R. W Tully, Box 4, Sierra Madre, Cal

WRIST-PIN.—Wherein the pin may be firmly fastened to the crank-disk, yet may be readily assembled with or taken from the disk Patent 1579090 O Teel, Echo, Ore.

MACHINE FOR CASTING STEREOPLATES.—In which the mold is pressed immediately against the pot, and the flow of metal regulated by a cock Patent 1579991 C Winkler, c/o Winkler Fallert & Co, Bern, Switzerland

FILM HANDLING MECHANISM FOR MOTION PICTURE PROJECTING MACHINES.—Which obviates the necessity of forming the film with feed perforations, thereby reducing the expense of manufacture Patent 1579953. P Roble, c/o J Montoya, Jr, 143 W 82d St, New York, N Y

MACHINE FOR BEAD MANUFACTURE.—An automatic machine for the manufacture of glass or enamel beads from a rod of material melted in a blowpipe Patent 1580076. J Paisseau 5 Rue Blondel, Courbevoie, France

SIGNATURE STAMP FOR MULTIGRAPHING MACHINES.—In the form of a rubber signature sheet with a flexible, elastic and con-

formable backing member thereby compensating for the variance in the diameter of the rollers. The inventor has been granted two patents, 1580009 and 1580010. H T Buck, c/o Buck Mfg Co, 87 Duane St, New York, N Y.

Bias Cutting Machine.—For cutting strips spirally from a tubular fabric so that the strips will be on a bias with respect to the weave. Patent 1581051. P Gardner, c/o H M Bunker & Co, 56 Worth St, New York N Y.

Twisting Device.—Operable by the bobbin winder of a sewing machine, for twisting together a plurality of strands to form a heavier cord. Patent 1581003. E N and F O De Meoer, Apartado 8404, Mexico D F Mexico.

Tube Cleaner.—For blowing the soot from either a water tube or fire tube boiler without interrupting the use of the boiler. Patent 1581005. J J McAndrews, 145 16 Greenbridge St, Jamaica South, L I, N Y.

Piston Ring Construction.—Whereby as the piston rings and their grooves become worn they may be very readily replaced, as compared with the present practice. Patent 1581053. J L Gibson, Room 808, 80 Broad St., New York N Y.

Evaporator.—For use in marine operations where salt water must be evaporated to provide fresh water for steam boilers. Patent 1580523. J A. Paul, 936 84th St., Brooklyn, N Y.

Blade and Shoe for Rotary Pumps.—Wherein the shoe is allowed to rock as the blade moves, always engaging the surface of the pump casing flatwise. Patent 1580713. W. B. Ensign, 2350 Creston Ave., Bronx, N Y.

Water Motor.—Adapted to be sustained in submerged position in such manner that it will operate when the water moves in either direction. Patent 1570723. F L. McQuiston, 817 Garnet St., Redondo Beach, Cal.

Fluid Cut-Off Mechanism.—Adapted to automatically cut off the flow of gas or other fluid when an abnormal temperature is reached, as in case of fire. Patent 1580277. C T Bard, 28 Lincoln Ave, Norwich, Conn.

Picker Stick for Looms.—Which may be readily replaced when desired by the release of a catch adapted to maintain the spring normally. Patent 1580345. C. W. Stossel, Front Royal, Va.

Regrinding and Reboring Machine.—Ordinarily employed in reboring but readily converted into a device for regrinding operations. Patent 1580379. J Locken, Comstock, Minn.

Windmill.—Provided with a novel form of packing member and means for maintaining the transmission shaft in a well-lubricated condition. Patent 1580388. J F Struble, 225 E "B" St., Hutchinson, Kan.

Starting Device for Packed Folded Paper.—Particularly the first unit of folded tissue such as is commonly used in lavatories. Patent 1579429. L J Arms, 2180 Green St., San Francisco, Cal.

Excavating Machinery.—Designed for digging ditches in mud work or for general purposes, a greater depth and width being cut than with ordinary machines. Patent 1581318. J O Laum, Christine, N D.

Concrete Mixer.—Wherein the discharge mechanism is readily controllable, may be shifted to an operable or inoperable position and is releasable. Patent 1581587. O G Mandt, c/o American Cement Machine Co., Keokuk, Iowa.

Slide-Shoe Attachment for Road Graders.—Which will tend to prevent irregular cutting movements of the scraper blades. Patent 1581414. H T Young, 124 Pearl St., Darlington, S C.

Catchall for Multiple Effect Evaporators and Vacuum Pans.—For use in sugar factories, for catching the heavy liquor carried by the vapors and returning the same back to the pans. Patent 1581220. P Mir, c/o Wm. Gawrie, Box 2, San Pedro de Macoris, Dominican Republic.

Trumpet for Cotton Machines.—A silver pan stop motion adapted for use with a stop motion apparatus of combing machines. Patent 1582159. A. J Blackwood, Box 86, Carrboro, N. C.

Roller-Bearing Pressing Roller for Drawing and Spinning Frames.—Whereby to bring about improved results in the action of the pressure roller on strands of wool, worsted or cotton. Patent 1582752. J S Hoyle, 34 Park St., Ware, Mass.

Half-Moon Roll-making Machine.—Capable of being worked by power or hand for forming the dough preparatory to baking the rolls. Patent 1582382. M. Collis, 165 King St., Charleston, S C.

Meat Cutter.—A motor driven implement for butchers' use, both for cutting the meat and sawing through bones. Patent 1582483. G B Runyan, Kusa, Okla.

Attachment for Addressing Machines.—For use on standard addressing machines, for permitting an operator to print the name, street and city address in various ways. Patent 1582743. H A. Foreman, Columbus Drive, Tenafly, N J.

Medical and Surgical Devices

Syringe or Pump.—For the transfusion of blood, wherein means are provided for drawing in blood from one patient, and forcing it into another. Patent 1585628. J A Pfaire, 107 E. 28th St., New York, N. Y.

Obstetrical Forceps.—Wherein the blades are arranged in the same plane as the handle with a single connection, one blade being independently pivotally mounted. Patent 1585523. L G Burton, c/o Geo Tiemann & Co, 107 E. 28th St, New York, N Y.

Prime Movers and Their Accessories

Attachment for Internal Combustion Engines.—Whereby gases within the crank case of an internal-combustion engine may be drawn into the intake manifold of said engine. Patent 1580739. M N Lebecque, Box 332, Gilbert, Nev.

Triple Seal Piston Ring.—In which the likelihood of escapement of the compression by leakage past the ring is lessened. Patent 1581484. H E. Deputy, Addison Hotel, Detroit, Mich.

Valve Silencer.—Adaptable to both tappets and cross arms for the purpose of silencing the spaced apart valve actuating parts. Patent 1583335. A F Borschel, 43 Welmont Place, Buffalo, N Y.

Internal Combustion Engine.—Which eliminates the tappet valve and the cam shaft, and substitutes a rotary overhead valve thus eliminating many parts. Patent 1582377. M Broadbere and J W Costello, Box 1111, Crescent City, Calif.

Reboring Appliance for Engine Bearings.—Of internal combustion engines, assuring perfect alignment, not only between the main bearings, but between the crank shaft and cylinders. Patent 1585020. A T Green, 202 3rd St., So Aberdeen, S D.

Rotary Internal Combustion Engine.—Of simple construction, economically operated, having a maximum power at low speed, and absence from vibration. Patent 1583,-560. J K Morris, 127 So Myrtle Ave, Monrovia, Calif.

Railways and Their Accessories

Slack Adjuster.—By means of which the brake will be applied uniformly to every car in a train, thus eliminating jerks. Patent 1581438. D Grattan, 2080 W. 12th St., Los Angeles, Cal.

Car-Stopping Device.—For use in lieu of a bumper for stopping cars at a terminal when approaching at undue speed. Patent 1581987. H H Shepard, Gen'l Supt., D, L & W. R.R., Scranton, Pa.

Coupler.—Particularly adapted for use in the coupling of railway cars, can be swung to releasing position while under stress. Patent 1582799. J. B. Stewardson, Colby, Kan.

Forced Draft Apparatus.—Which will supply the necessary air draft to insure a full and complete combustion for locomotives burning hard coal. Patent 1583726. P F Lynn, c/o F J Flannery, 117 Market St., Pittston, Pa.

Combined Metallic Tie and Fastener.—The inventor has been granted five patents of a similar nature for combination concrete and metallic ties, wherein a tie with clips is so arranged that the rail may be renewed without disturbing the tie, the ties are also capable of being insulated for use in block signal systems. Patents 1586,049, 1586050, 1586051, 1586479 and 1586,-480. J G Snyder, c/o Keystone Metal Tie Corp., 441 Lexington Ave, New York, N Y.

Structural Metal Beam.—Capable of use for structural work for metal ties or other purposes, with certain parts so formed as to be bent to act as shoulders, the beam may be used in any length with either open or closed ends. The inventor has been granted two patents 1586052 and 1586053. J G Snyder, c/o Keystone Metal Tie Corp., 441 Lexington Ave., New York, N. Y.

Locomotive-Frame Binder Support.—Which provides a substantial and durable securing means, with easy removal and replacement of the binders. Patent 1585507. A. H. Miller, 712 Mitchel St, Clovis, N M.

Pertaining to Recreation

Game Apparatus.—For playing a game after the manner of ten pins, bowling or pool, the ball being propelled by a cue. Patent 1580036. W A Haegele, 717 Grove St., Elizabeth, N J.

Amusement Apparatus.—To be erected on fair grounds and like places for the purpose of giving persons the sensation of flying in an airship. Patent 1580460. D S. Willeford, 1524 20th Ave., Oakland, Cal.

Toy Gas Filling Pump.—Which in operation has the same appearance as the pumps used at automobile service stations. Patent 1581008. C. G Austin, 703 Clay St., Woodstock, Ill.

Toy Airplane.—Primarily designed for the amusement of children and made in such manner that it may be readily assembled. Patent 1581060. F. Parsons, Fort Omaha, Neb.

Game Apparatus.—Which affords facilities for playing a game which is in the similitude of the game of baseball. Patent 1582150. J W Weaver, 415 Cutler St, Raleigh, N C.

Golf Ball.—Provided with visible signal means permitting the owner, or others, to locate the ball in tall grass, for instance. Patent 1583721. P S. Kane, Kane, Pa.

Game.—Comprising a board representing a battle area, and tokens or pieces in the form of battleships. Patent 1584668. J Sjogren, 152 Beaver St., Hyde Park, Mass.

Protecting Glove for Playing Handball.—Including simple effective reinforcement for those parts upon which the greatest strain is thrown, thus avoiding premature breakage. Patent 1584304. B. Kennedy, c/o Ken-Wel Sporting Goods Co, Gloversville, N Y.

Roller Skate.—Adapted for use in playing hockey, constructed with three wheels, and a special guard between the axles for stopping the ball. Patent 1583193. F R. Shugart, 3957 4th Ave., Sacramento, Calif.

Pertaining to Vehicles

Leaf-Spring Lubricator.—Having means for quickly and easily spreading the leaves and injecting grease into the space between. Patent 1578600. R. W. Ammons, 2516 Central Ave., Los Angeles, Cal.

Tire.—Comprising a plurality of separate and independent inflatable sections, any one of which may be renewed without disturbing the others. Patent 1579674. A. Teresa, c/o Compania Hespena Americana de Heneguen, Nuevitas, Caw, Cuba.

Automobile Lock.—Which affords facilities for releasably holding an operating lever, such as the emergency brake, against movement from a given position. Patent 1581035. T J. Stephenson, P O Box 642, Montrose, Cal.

Press for Leveling Magnet Assemblies.—For facilitating repair work on a well known type of automobile, in which magnets are assembled in connection with the flywheel. Patent 1580426. R. A. Farnam, Box 908, La Grange, Oregon.

Power Transmission.—Whereby power can be transmitted from one rotary element to another at a changed speed ratio without shifting any gears. Patent 1579433. J H Blair, 447 Valencia St., San Francisco, Cal.

Method of Damping Oscillations in Leaf-Springs for Vehicle Suspension and Other Purposes.—By a special form of curvature of the leaves and a special form of maintaining the straps in position. Patent 1581916. F L. Broussouse, c/o Office Picard, 97 Rue St. Lasare, Paris, France.

Creeper.—For the purpose of enabling a mechanic to move more readily beneath a motor vehicle. Patent 1581592. F. R. Neal, 76 Brentwood St., Woodfords, Maine.

Ullage Calculator.—Which will allow filling station operators to accurately ascertain what amount of gasoline is necessary to fill an automobile tank. Patent 1580520. O. A. Petree, Palo Alto, Cal.

Ignition Tester.—Which may be so positioned that the control will be on the dashboard of an automobile, and any one cylinder may be tested. Patent 1581976. W. V. Moore, c/o Wm. V. Kulp, 40 Wall St., New York, N. Y.

Radiator Indicator.—For use on automobiles for showing the temperature condition of either the water in the radiator or the engine. Patent 1581460. A P. Anderson and A. L. Tyrrell, 418 Helen Ave., Detroit, Mich.

Wheel.—In which the felly has novel means for engaging with both sides of the rim to provide a larger supporting surface. Patent 1581639. S. Kaplan, Monroe, La.

Sled Runner for Coasters.—Quickly attached or detached from a wheel, such as are used on baby carriages, gocarts and wheeled coasters. Patent 1581420. E. B. Beeler, c/o S J Harbaugh, 2721 S. Michigan Ave., Chicago, Ill.

Wheel.—In which positive means is provided for preventing movement of the rim with respect to the felly. Patent 1581348. S Kaplan, Monroe, La.

Crank-Case Draining Device.—Which may be readily operated to disconnect the oil plug and receive and carry off the old used oil. Patent 1582758. H A. Jones, 6th Ave and Van Buren St., Phoenix, Ariz.

Car Fender.—Whereby in the event a person is struck by the automobile he will be tripped and caught in the fender. Patent 1582720. J C. Buchanan and E. R. Bishop, 202 Lillian Ave. and Eastwood St., Syracuse, N. Y.

Spare-Tire Safety Guard.—Which functions as an enclosure to protect the tire and permits of carrying articles within the space. Patent 1583650. J P Clarke, 1410 Boulevard, West New York, N J.

Emergency Brake and Safety Lock Combined.—Adapted to be dropped upon the ground so that the rear wheels of the vehicle will run up thereon and quickly stop. Patent 1582911. F A. Eichorn, 208 Walnut St., Chattanooga, Tenn.

Air-Releasing Device.—To be attached to the valve stem of a pneumatic tire for permitting the escape of the surplus pressure fluid. Patent 1582928. D H. Hoag, Black Hoof Station, Nemadji, Minnesota.

Spark Retarding Motor Starter.—For Ford cars, which will do away with the foot pressure starter, and avoid the dangers of starting with the spark advanced. Patent 1583408. R. O. Simms, and H. B. Mattox, Leesburg, Fla.

Bumper.—In the form of an air-filled cylindrical element of resilient material, for use on the extremities of the chassis. Patent 1584061. J L. Douglass, 102 Maiden Lane, New York, N Y.

Exhaust Stove for Automobiles.—Adapted to be connected with the exhaust manifold, to form a heating chamber for receiving a plurality of cooking vessels. Patent 1584514. G Doster, Burbank, Calif.

Warning Signal.—Which will resist closing of an automobile door or a filing cabinet, when a hand is in proximity of the opening. Patent 1584521. D F Ebbert, Main and 4th Sts., Wheeling, W Va.

Designs

Design for a Ceiling Fixture.—Patent 69971. M Schlepp, c/o Sterling Spring & Stamping Works, 476 Broome St., New York, N Y.

Design for an Article of Footwear.—Patent 69987. T. Davis, c/o Franklin Simon & Co., 38th St. and 5th Ave., New York, N. Y.

Design for a Deck of Cards.—Patent 70062. W. T. Seto, 99 Quincy St., Brooklyn, N. Y.

Design for a Combination Calendar and Kitchen Memorandum Card.—Patent 69907. L. R. Keller, 100 W. 105th St., New York, N Y.

Design for a Wall Bracket.—Patent 70144. P Siptrott, c/o Munn, Anderson & Munn, Woolworth Bldg., Broadway, New York, N Y.

Design for Decorative Toy Animal or the Like.—The inventor has been granted five patents of similar nature. 70189, 70190, 70191, 70192, 70193. A. W. Samuels, c/o Vogue Merchandise Co., 91 5th Ave., New York, N. Y.

Design for a Paper Weight or Similar Article.—Patent 70173. A. M. Heitz, 667 Ponce de Leon Ave., Atlanta, Ga.

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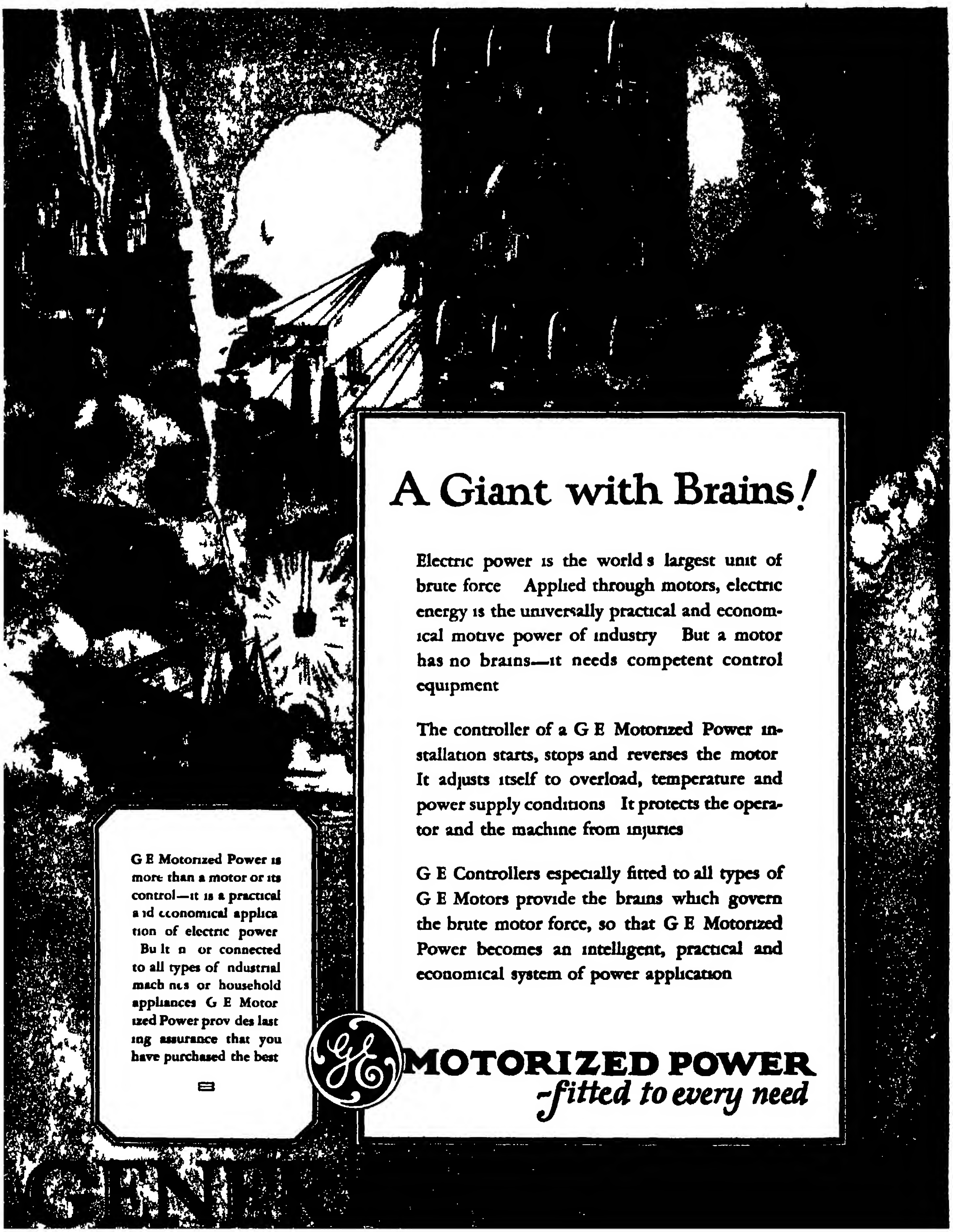
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SCIENTIFIC AMERICAN

ARE WE OVER THE POLE?
By Nell Ray Clarke

A TWENTY-FIVE FOOT EYE

WHAT LOWERED THE GREAT LAKES?

ST. GEORGE REEF LIGHT, CALIFORNIA

SEPTEMBER 1926

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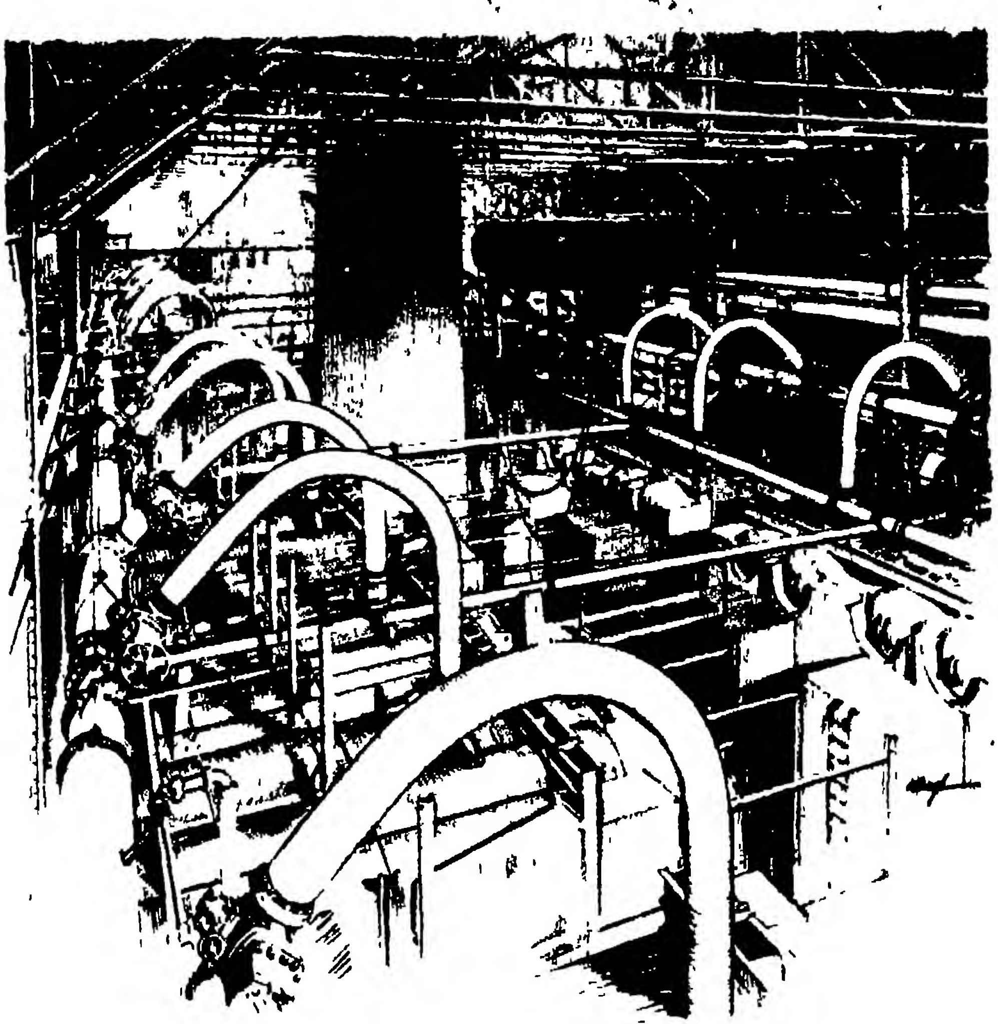

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Above a view in the boiler house of Plant No 4, Northampton Pennsylvania, of The Atlas Portland Cement Company, makers of Atlas Gray and Atlas White Portland Cement. The Crane piping materials illustrated are now twenty-two years old, and are still operating as originally installed by the Atlas power department

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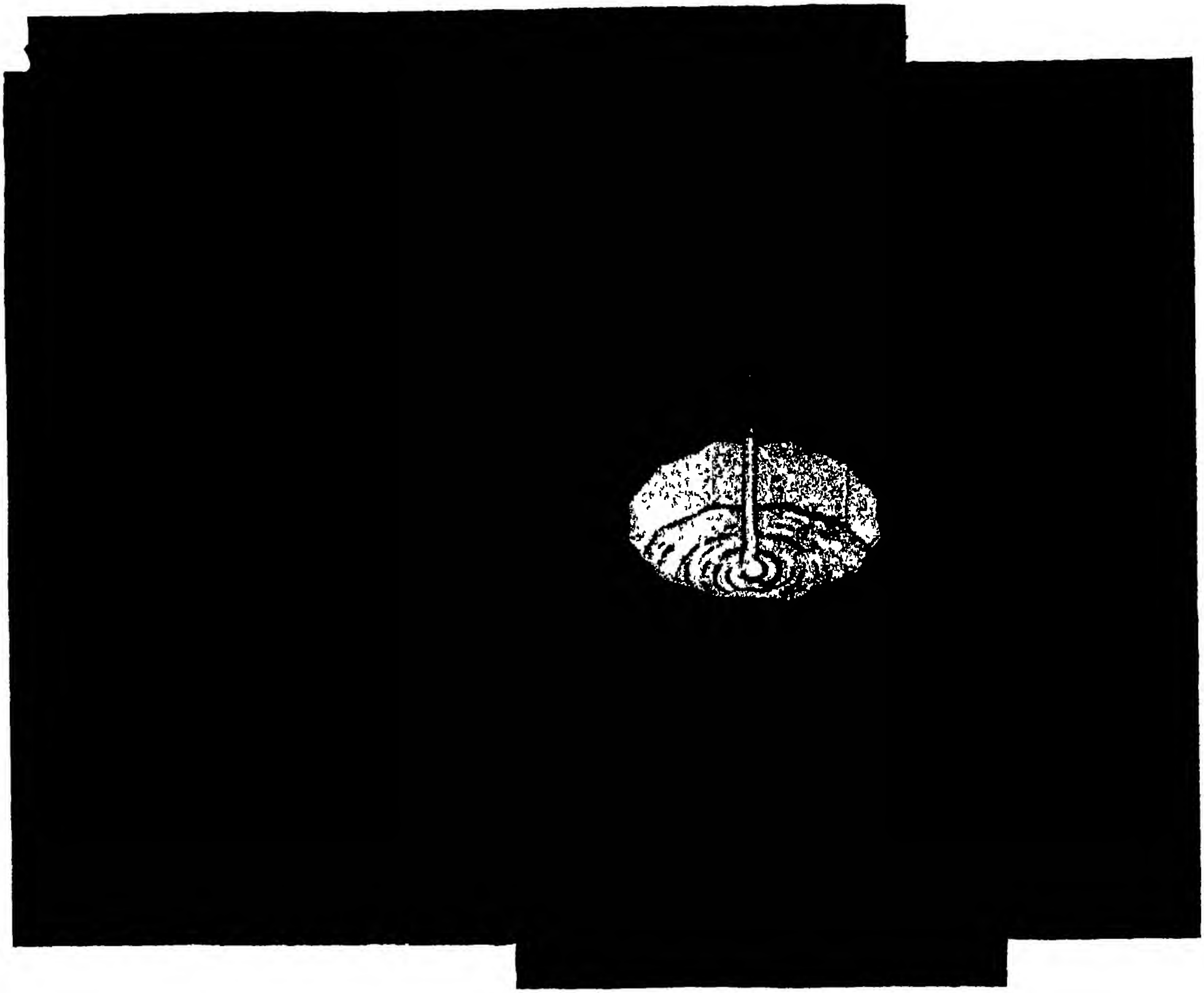

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SCIENTIFIC AMERICAN

THE MAGAZINE OF TODAY AND TOMORROW

NEW YORK, SEPTEMBER, 1926 — *Edited by* ORSON D. MUNN — EIGHTY-SECOND YEAR

EVOLUTION

TENNESSEE forbids the teaching of evolution in state-supported schools. The Florida House of Representatives passes a resolution having similar aspirations. Kentucky barely defeats an anti-evolution bill, another is threatened. In North Carolina the High School Textbook Committee removes two school books from the list—they contained matter on evolution. In Louisiana an anti-evolution bill passes the lower House, but the Senate postpones the issue. And now comes Texas, whose State Textbook Commission draws a black line through every mention of the word evolution in biologies, substituting therefor the word "development," thus beating the devil around the stump What next?

They say that in these states people who never before heard of evolution are inquiring into it, finding it interesting. Boys, denied the forbidden subject at school, furtively read about evolution from booklegged treatises, down behind the barn, where their fathers once read "Pluck and Luck," "Fred Fearnot" and "Diamond Dick," the while smoking cigarettes concocted of cornsilk.

To forbid is to recommend These state legislatures are doing a great work for evolution

SUBWAYS

ROME is to have a subway. That ancient city, beneath whose streets rest thousands of historical relics, is to be modernized to the extent of having what New Yorkers refer to as "sardine cans on wheels." The present plan is to build seven lines with a total mileage of twenty-two, the constructional work to cover a period of ten years. It is expected that the necessary excavations will bring to light priceless records of ancient civilization In order to preserve these, archaeologists will cooperate with the construction engineers during the work and will carefully save as many of the relics as possible

MOSQUITOES

SOME of us have been worried about the Grand Canyon We heard rumors that it was rapidly being filled up with tomato cans thrown into it by tourists.

We shall worry no longer The United States Public Health Service has found a way out H. B Hommon, sanitary engineer of the Service, has devised a can crusher This he recommends especially for use in national parks where empty food cans strewn about constitute a serious problem. Not only are tin cans unsightly, but when it rains they become partly filled with water and breed mosquitoes.

In This Issue

Who Built the First House?

Nobody knows, but a noted British archeologist has discovered parts of a house that may be 100,000 years old—longer than modern houses last! See page 170 for the account of this remarkable find.

How Did Byrd Find the Pole?

When Byrd flew northwards over the trackless ice floes, he knew exactly where he was "at" every minute. This appears to have mystified many people The apparatus that he used was simple, the methods equally so On page 188 they are lucidly explained.

A Brobdignagian Telescope

Astronomers have planned a telescope beside which the largest now in existence is but a dwarf. It will cost a fortune. What will it reveal? Page 174.

Is Cousin-marriage Injurious?

Yes, says tradition hoary with age. Many states forbid it by law Now comes the modern science of genetics, accepting nothing, testing all things, and says cousin marriage is not necessarily injurious For a famous example, see the narrative on page 182.

What Happens?

When things go wrong, what happens to a high-voltage transmission line? Surges of terrific voltage, interruption of power, trouble—these happen. How to eliminate these damaging surges—this was a recent problem It has been solved Page 176

MORE THAN 200 PICTURES

Complete table of contents will be found on page 210

For Next Month

Cold Light—What Is It?

When man makes artificial light he wastes most of the power producing heat. Deep-sea fishes have far more efficient light-plants than man—when they make light they make light alone Next month, Dr. David Starr Jordan, world famous scientist, will explain these fish.

The Wonders of the Commonplace

Most of us take Nature and science too much for granted. Yet there are "sermons in trees and food in everything" We miss many marvels simply because they are so commonplace Next month a noted government scientist, Dr Paul R Heyl, will point out for you some of these wonders

Marconi Was Right!

Beam radio and short waves have "come in," decidedly They have come even more quickly than Marconi predicted less than five years ago, thanks to the amateur In our next issue Mr Dunlap will explain some of the marvels of short wave transmission and reception

Other articles on Ancient Ice Ages, The Japanese Beetle, Hay Fever, The Chicago Drainage Canal, New Developments in Automobile Engines; The Peabody Museum, Domestic Oil Heating, Conservation; Astronomy, Radio

MORE THAN 200 PICTURES

MYTHS

THERE is no such thing as a "wet moon" or a "dry moon," the Weather Bureau finds it necessary to remind the public The moon has nothing to do with rain, and the old saying that the moon portends wet weather because it tips like a pitcher pouring out water, or that dry weather is due because the tips of the crescent are tilted upward, is nonsense.

Why? Viewed from near the earth's equator the young moon never makes an angle of more than 30 degrees with the horizontal and it is generally more nearly horizontal, or "dry," than this. Yet are the tropics dry? And at the earth's poles a line drawn through the horns of the moon's crescent is always within 25 degrees of vertical—"wet" moon! Yet the polar regions are really among the more arid regions of the globe.

Brushing aside this age-old myth is only a little thing, but it illustrates perfectly the job of science—to replace superstition with knowledge

SAFETY

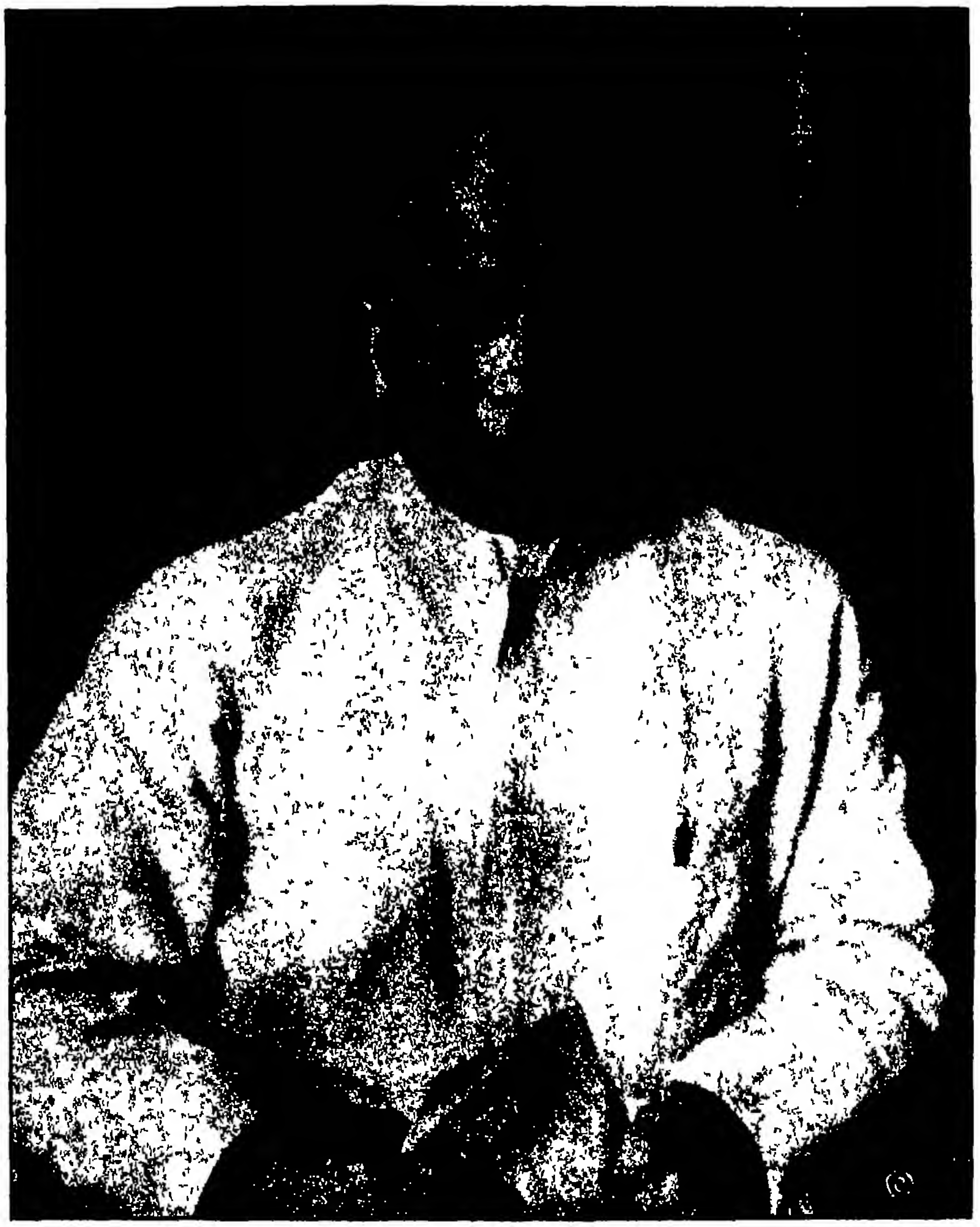
THE non-explosive quality of the helium gas with which our airships are filled, is, of course, a great protection But although there is no danger from the gas which lifts the dirigible, there is danger from the gas which drives it The hazard from fires and explosions of gasoline vapors in any rigid airship is very real, and although every possible precaution is taken, the mere presence of tons of gasoline aboard a ship constitutes an ever present threat Hence, the Navy has turned its attention to the heavy oil engine, and it is gratifying to learn from the Secretary of the Navy that preliminary tests of experimental oil engines now under development by the navy have proved satisfactory

CHECKMATE

OUR British contemporary, *English Mechanics*, states that the Duke of Bridgewater, when in charge of an important engineering job, noted that his workmen frequently failed to return to work when, after the dinner hour, the clock bell struck one As an excuse they told the duke that they had failed to notice the single stroke

So the duke "went them one better" He had the clock altered so that at one o'clock it struck thirteen! Nobody could say he had failed to notice *that*

Our suggestion would have been, to make the clock strike once at twelve o'clock, and twelve times at one o'clock We feel sure that not a man would fail to hear the single stroke at quitting time



Dr. Alexis Carrel, Noted French Scientist of the Rockefeller Institute

Few men have conferred greater aid to mankind than Dr. Carrel. Born in France in 1873, after several years of service in Lyons as an interne, he came to America in 1905. Four years later, Dr Carrel became a member of the famed Rockefeller Institute for Medical Research in New York. In 1912, he was honored with the Nobel Prize, for his remarkable work in suturing blood vessels and the transplantation of human organs. When the World War came, he dedicated his services to his native France, serving through four years of the great struggle and working out a method of applying Dakin's Solution to wounds, which quickly reduced the average of mortality from high to extremely low. The Carrel method is remarkably simple. The wound is repeatedly irrigated with Dakin's Solution—a hypochlorite of soda, costing only a cent a quart. Through rubber tubes, it reaches all parts of the wound, maintaining a continuous action of the antiseptic. Infection is suppressed, the wound is sterilized and the patient's chances of recovery are increased many times. Since the war Dr. Carrel has remained attached to the Rockefeller Institute, engaged in new researches

The Entrance to the Gennadeion

This exquisite example of architecture recalls the carvings of the north doorway of the Erechtheion. The Ionic columns of the main façade, two of which are shown, are each composed of three circular blocks or drums of Pentelic marble, each being two feet, eight inches in diameter and seven feet high. These heavy blocks of the fine stone were hauled down the mountain side by hand power, being placed on skids for this purpose.

American Building Methods in Greece

How the Gennadeion, Library of the American School of Classical Studies at Athens, Was Built in Two Years and Two Months

By Gladys Thompson

IN 1922, Dr. and Mme. Johannes Gennadius decided to present their magnificent collection of books, known as the Gennadius Library, to the American School of Classical Studies at Athens. The gift was a great one, for the collection comprises between 45,000 and 50,000 items relating to Greece—ancient, Byzantine, and modern, as well as many first editions and 800 rare and unique bindings. The Carnegie Corporation gave the money for a fitting and worthy building to house this collection which, although the property of the American School of Classical Studies, is to be accessible to scholars of all nations. The firm of Van Pelt and Thompson of New York City was commissioned to design and erect the building by the committee of which Dr. Edward Capps of Princeton University was chairman.

The library, called the Gennadeion in memory of the father of Dr. Gennadius, is a simple rectangle in form with a façade of eight Ionic columns of the Erechtheion type, a decorated cornice, and a large inscription in Greek on the frieze which announces that all who share in Greek culture are Greeks. Extending at right angles to the library and forming a mammoth forecourt are residence buildings for the librarian and the annual professor These residences are connected with the library by colonnades of twelve marble columns All the exterior of the building is made of marble, except a Piraeus stone foundation, and, although the building stands in Greece, the home of the most famous marble quarries in the world, it was marble that was the most difficult material to get for the building

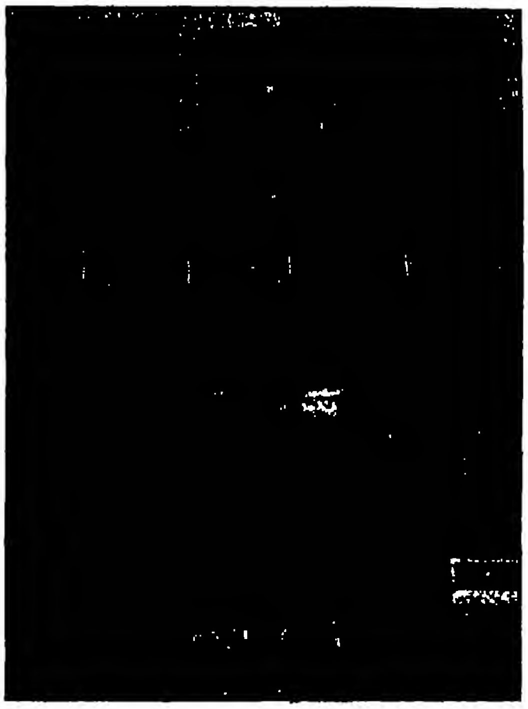
Labor for 35 Cents a Day

Mr W. Stuart Thompson arrived in Athens in April, 1923, to let the marble contracts himself He estimated that about 1,000 tons or about 500 cubic meters of marble would be needed for the building. Mount Pentelicus, so often thought of as that inexhaustible supply of beautiful white marble of the Athenian Acropolis, seemed the natural source for the bulk of the Gennadeion marble It lies only eleven miles to the northeast. Visits to the various quarries on Pentelicus were most interesting but disappointing to one seeking more than a few window sills and first story blocks for a private residence. Actually there is very little available of the far-famed beautiful white marble. The ancient quarries are very deep, and, in inspecting modern openings in other places on the mountain side, one marvels at the labor and expense which were evidently necessary to obtain marble comparable to that on the Athenian Acropolis.

Ordinarily, in speaking of Pentelic marble, one visualizes a beautiful clear white stone of excellent quality which, after long weathering by time, gradually takes on a gorgeous yellowish tint due to the iron in its composition. Actually this quality is obtained only by cutting out great strata of marble which vary in color from a light gray to a coarse blue slate. It also runs spotty in color. Upon careful inspection of the most promising Pentelic quarry it was estimated that it would take a minimum of five years to quarry the desired cubage and that the expense would be far too great. Hymettos, famous in ancient times for its marble, lying to the east of Athens, had nothing at all to offer. So the historic quarries of the Greek mainland and islands were canvassed.

Naxos, the largest of the Cyclades, in the Aegean Sea, 110 miles from Athens, had quarries where the desired cubage of a good quality white marble could be obtained in about fourteen months It was from here that the bulk of the marble came for the Gennadeion, and it is interesting to note that in an ancient Naxian quarry, not worked today, there still lies *in situ* an unfinished colossal statue of Apollo

Actual construction was started on September 1, 1923. Mr. Thompson, a former Fellow in Architecture in the American School and a lover of Greece, settled down to supervise the work. As no contract could be let in Athens due to the tremendous fluctuation in the drachma, the Greek unit of money, and



SOUTH WALL OF READING ROOM

On the wall over the doorway in the above illustration are the portraits of Dr. Johannes Gennadius, Dr George Gennadius and Mme. Johannes Gennadius

the great instability of all kinds of business caused by the Smyrna disaster and the enormous influx of refugees, the labor market of Athens was drawn upon and ten refugees were hired to start excavating the foundations. The news spread through Athens that work could be had at the Gennadeion, and the next morning there were hundreds of men and boys swarming over the locality It was necessary at once to build a barb-wire fence around the property to keep out the labor which could not be used.

During the excavating, common labor was hired for three day periods only, so that work could be given to as many as possible. These men were newly arrived refugees, and although Greek nationals, could often speak only Turkish They fought to work for 35 cents a day Earnest expressions of gratitude were sent to Professor Capps of Princeton, Chairman of the Managing Committee of the American School, and to the Carnegie Corporation for work already given and the work to come

Unskilled labor was begging for work but first-class, trained workmen were nearly impossible to find Carrying out definite instructions, even of the simplest, is something a Greek laborer cannot be depended upon to do He prefers trying some other way, or, if he has the opportunity, several ways. With this natural propensity, plus a lack of training, it was necessary to check over most carefully everything delegated to anyone to do Gradually a nucleus of trusty men was formed They were refugees and for the most part lived on the job

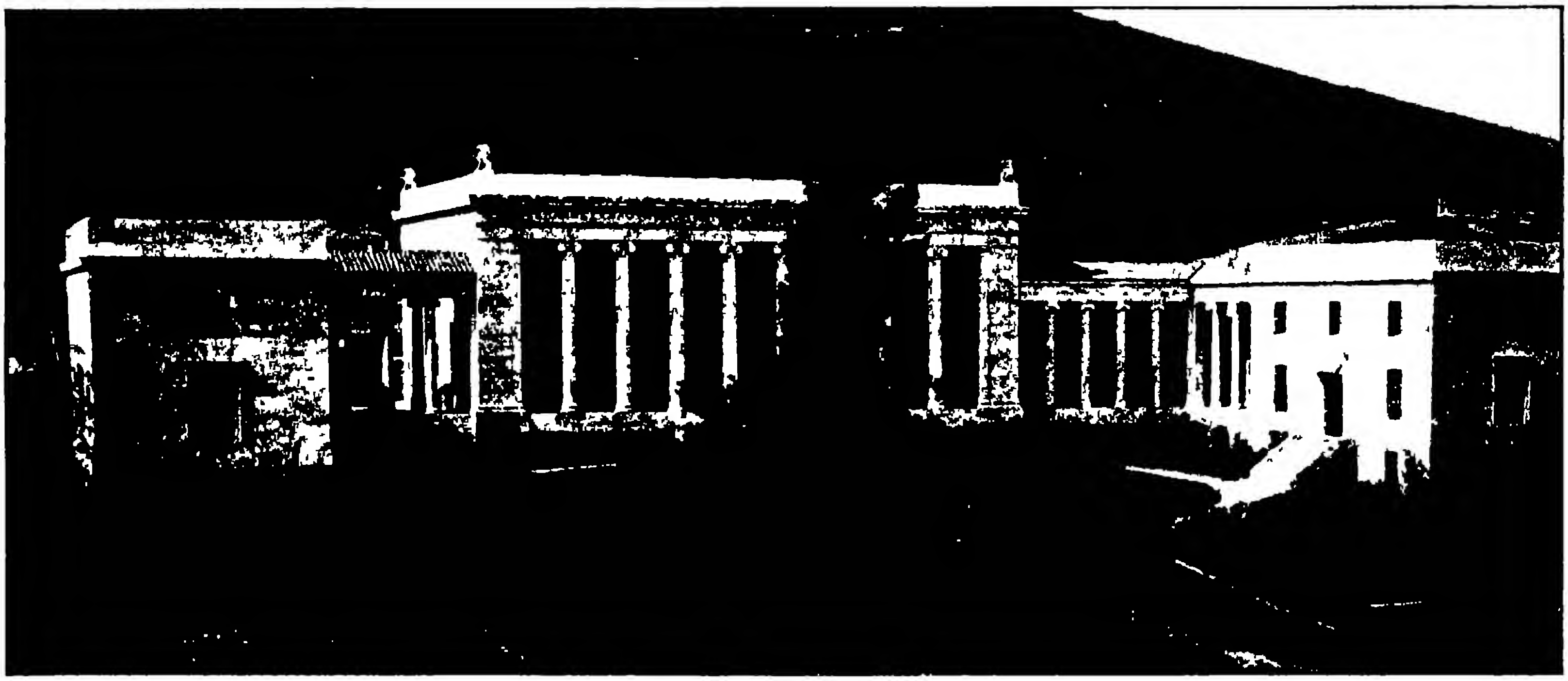
All marble was delivered in rough blocks as quarried. It was cut, polished, and rubbed down by hand on the building site The methods and tools in use were the same as used by Iktinos and Kallikrates, the architects of the Parthenon. It took 99 working days for an expert marble cutter to finish one of the capitals for the main façade. Such a worker allowed for the variations in resistance caused by the differences in grain of the marble. In this connection it is interesting to note that there is only one hand-cut marble building in America, and that is the Morgan Library

The marble was set under the supervision of an American stone setter who used modern derricks These derricks were a great delight to the workmen It was necessary to watch them constantly to keep them from playing with the derricks to see how they worked. As marble foreman, the man was engaged who had been in charge of the repairs on the Acropolis Gradually a force of expert marble cutters, collected in Constantinople, the interior of Asia Minor, and the Greek Islands, was concentrated at the Gennadeion With them they had all their worldly possessions of a few rags In skill they far surpassed any marble cutters that could be found in America

All Work Done on Site

The Gennadeion was now a very interesting place as all work usually done in shops or factories in America was done on the site Small shops were run, all the ornamental iron was forged, necessary woodwork was finished and every piece of marble was cut and polished in much the same way as buildings were built hundreds of years ago Workmen in Greece still belong to guilds, and the trade is handed down from father to son. In the marble shed there were three generations of marble cutters.

The Athenian architects and engineers were much interested in American methods of working and visited the building often. The Professor in Engineering in the University brought his classes there regularly to inspect the different method of building with stone setting derricks from the interior of the building and without exterior scaffolding The proper mixing of concrete and the pouring of floor panels caused much interest The concentration of one man on a particular job instead of dropping his work to get new materials, as is the accepted procedure in Athens, caused much comment The fact that all plumbing, steam fittings and electric wires were concealed before the building was plastered was an exciting novelty In Greece a building is completely plastered before plumbers, steam fitters and electricians are called to do their work They then cut holes in the finished walls and floors and leave exposed most of the pipe and wire An experienced plumber was brought from America, paid 16 dollars per day plus board and traveling



THE GENNADEION IN ITS COMPLETED FORM

This view shows the magnificent structure silhouetted against Lycabettus, as seen from the roof of the American School of Classical Studies

expenses, and still fifty percent was saved over the estimates given by local firms

It was not possible to purchase in Greece the materials for the interior finish These materials were quite international in origin, bronze grilles and doors, woodwork, steel, plumbing and heating materials came from the United States, glass from Belgium, fabrics from France, steel bookcases from England, while all furniture was especially made in Budapest and Vienna

These imported materials were easy to get It was the lack of marble that constantly caused concern and delay Naxian marble could only be loaded on caiques when there was a south wind Sometimes contrary winds held back the marble for two weeks or more Then, again, owing to the stratification of the marble, cornice blocks were cut when blocks were urgently needed for the lower courses Three special trips were made to the quarries to expedite the shipping of marble Due to the precipitous and inaccessible mountain passes, days were needed to make the trip Traveling in a little boat the Aegean Sea is no more dependable now than in the days of Homer On one of these excursions the boat was becalmed for sixteen hours and on another its occupants were nearly drowned in a terrific storm To speed up the quarrying of marble, men were employed running in three daily shifts of eight hours each

The Library of the University in Athens, the only other modern marble building comparable with the Gennadius group in size, took sixteen years to build, the Gennadeion, with the exception of the fluting of the main columns, two years and two months

The twenty four columns of the two side arcades are monoliths Each one is eighteen feet high, has a diameter of one foot six inches and weighs about three tons The heaviest single pieces of marble are the two lintels, one being over each balcony in the two residences in the Gennadius group Each lintel weighs four and one quarter tons, is fifteen feet six inches long and two feet high

Marble of Various Colors Used

The unexpected appearance of a blue stratum in the Naxos quarry prevented the main columns coming from there A new opening on Pentelicus gave a marble of exactly the same quality in color and texture The entire output of this quarry, representing fourteen months' labor, was used to supply the necessary eight columns for the main façade Each column consists of three drums, the drums being two feet eight inches in diameter and seven feet high The heavy blocks of marble were brought down the steep mountain side on skids by hand It took eleven days to cover the eleven miles

Skyros marble in many varieties of color and veining have been used in the Gennadeion for decorative purposes In two contrasting colors it makes a beautiful wainscot for the chief façade In the vestibule of the library, six variations of this exquisite marble are employed, ranging in color from the most beautiful alabaster white to the deep gold and violet veined specimens Throughout the group of buildings the mantelpieces have been made of the orange yellow white and slightly violet veined Skyros None of this Skyros marble could be bought in the open market in Athens It was necessary to buy it from an English company which had bought all the available supply of the material for shipment to America

The ancient Greek color palette composed of the three primary colors, red, blue and yellow, plus a small amount of green and a liberal use of gold as a blending medium, has been used for the decoration of the ceiling of the main colonnade and for the wall decorations of the interior of the building The addition of color to the exterior has greatly enhanced the beauty and grandeur of the whole group

The Gennadeion was dedicated on April 23 Dr and Mme Gennadius, Dr Henry S Pritchett, President of the Carnegie Corporation, and Mrs Pritchett, Judge William Caleb Loring, President of the Board of Trustees of the American School, Professor Edward Capps, former Minister to Greece and Chairman of the Managing Committee of the American School, and Mrs Capps, as well as a large representative group of prominent archaeologists and classical scholars and delegates from seventy five American and foreign universities attended the impressive ceremonies

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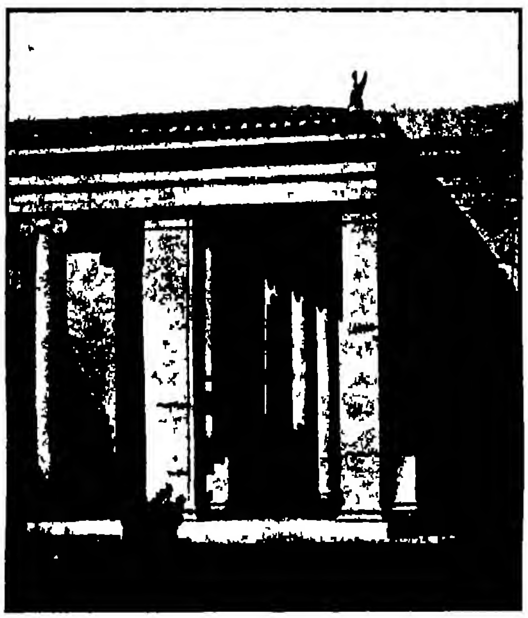
The Japanese beetle, an insect pest that is destroying vegetation in the eastern United States, is being fought with other insects Read about the battle for the preservation of crops in our October issue.



THE EAST ARCADE

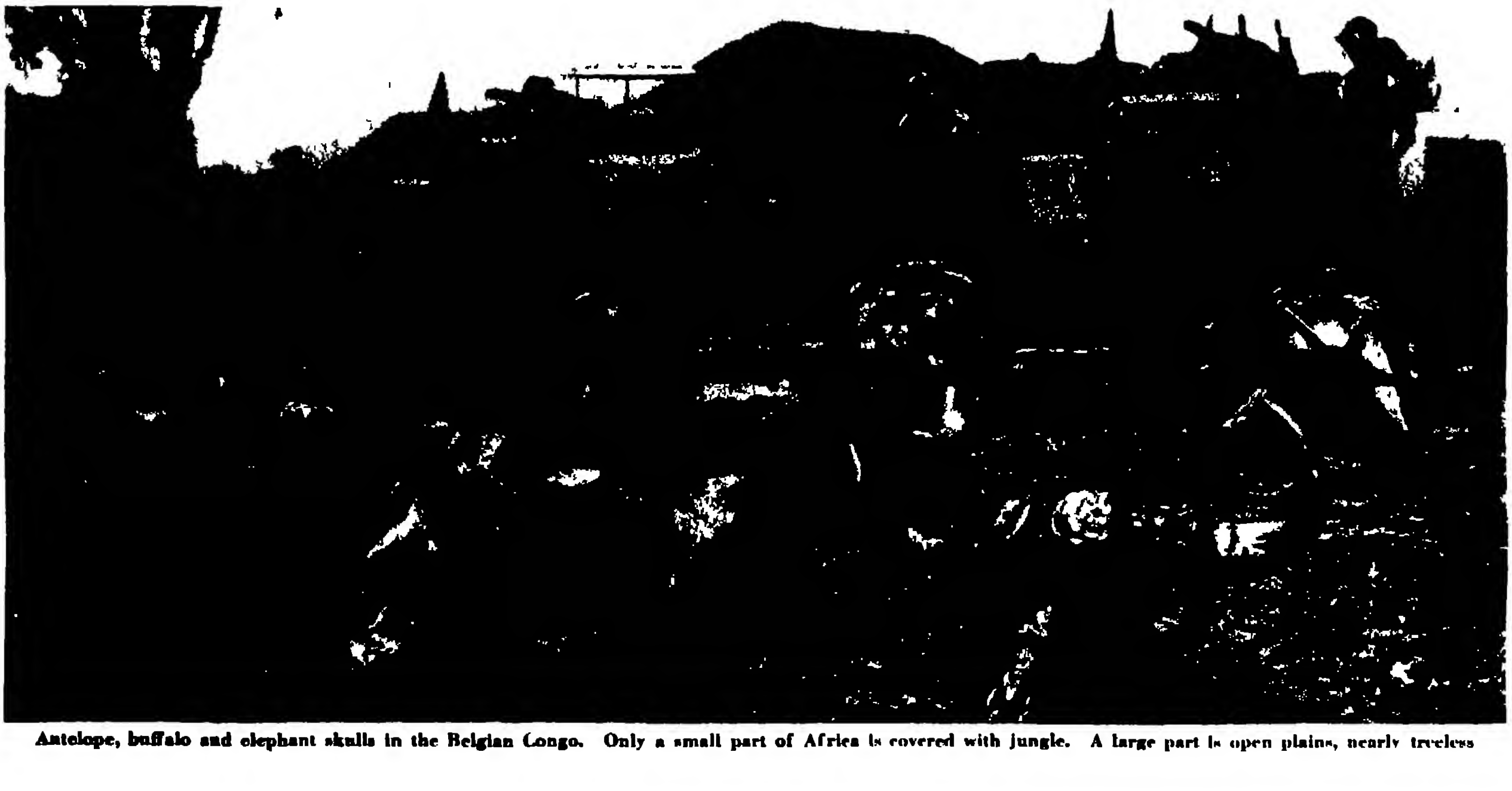
This connects the main building with one of the residences

THE MAIN COLONNADE

Looking east between the building and the row of columns

The Haardt and Audouin-Dubreuil, French, trans-African motor expedition stops near the Anglo-Egyptian Sudan to permit its taxidermists to prepare the skins and skulls of animals killed in the bush. With eight cars equipped with endless treads this expedition traversed Africa from Algeria in the northwest to Madagascar in the southeast, reaching that island which, like Algeria, is a French possession, by boat

Feet of the rhinoceros, hippopotamus and elephant, considered a great feast by the natives, and converted by the white man into waste paper baskets. During the past two years Africa has been covered with a network of motor traverses, and the "Dark Continent" is rapidly losing its aspect of darkness. Railroads, motor roads and plantations are displacing black man and beast. Those who would see "wild" Africa must hasten



Antelope, buffalo and elephant skulls in the Belgian Congo. Only a small part of Africa is covered with jungle. A large part is open plains, nearly treeless

REMAINS OF THE WOODEN HABITATION

Figure 1 The planks were held in place by means of stakes

UNCOVERING THE NORTH SIDE OF THE VALLEY

Figure 2 The wooden habitation was found in the lower two-foot stratum (See Figure 6)

Was the Cave Man a House-builder?

The Remains of a Crude Wooden Structure, Probably Built by the Long-extinct Neanderthal Man, Have Recently Been Unearthed in England

By J Reid Moir

Fellow of the Royal Anthropological Institute of Great Britain and Ireland

ALTHOUGH there has now been discovered in various parts of the world an enormous quantity of prehistoric implements made of flint and other rocks together with a number of artifacts in bone and ivory, especially the remarkable finds made recently at Predmost, in Moravia the records of the finding of examples of ancient man's handiwork in wood are by no means so numerous

We know that wood was used extensively in prehistoric times in the construction of lake dwellings and similar structures but the remains of terrestrial dwellings made of wood and of Stone Age date are met with but rarely The reason for this may perhaps be that wood unless subjected to certain favorable conditions disintegrates and disappears during the slow passing of the centuries

It may therefore, be of some interest to learn that I have recently discovered in the brickfield of Messrs A Bolton and Company Ltd in the northern portion of Ipswich in eastern England, the remains of a wooden structure that may be of considerable antiquity

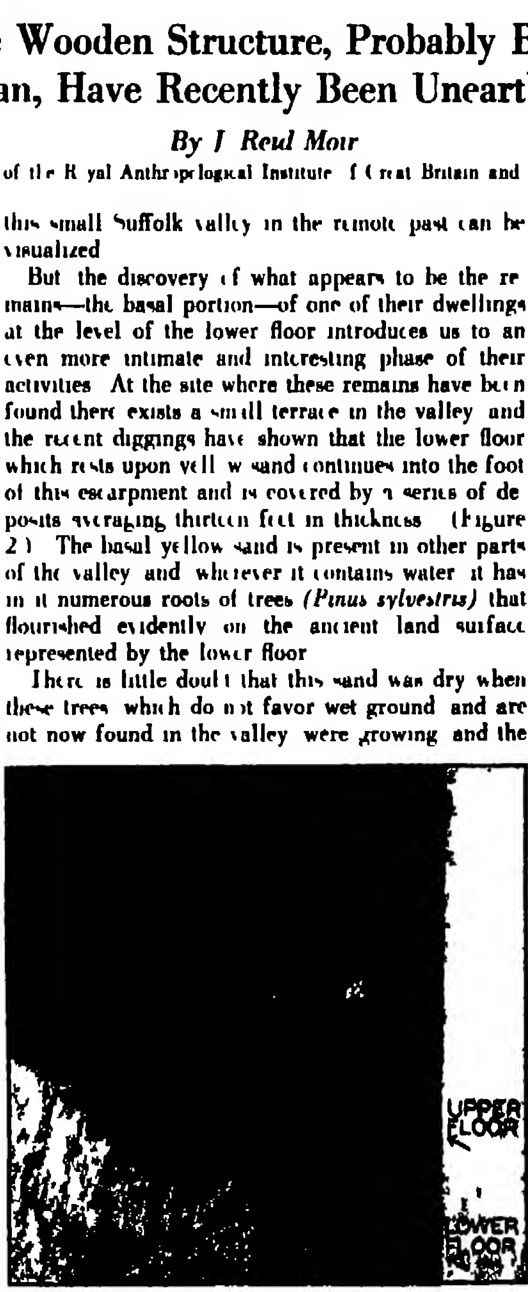
The Oldest "House" of All

The archaeological diggings which have been carried out under the auspices of the Percy Sladen Memorial Fund and by the kind permission of the directors of the brick works were undertaken in the north easterly portion of the small streamline valley in which these works are situated

Embedded in the deposits which now cloak the sides of this valley are two superimposed floors (Figure 3) or ancient occupation levels, at which a large number of flint implements flakes and hammerstones together with hearths fragments of coarse pottery mammalian (including mammoth and some human bones comprising fragmentary portions of a femur humerus and a thick skull) have been found In fact from the relics already recovered a more or less complete picture of the hand axes points, scrapers (Figure 5) and rough pottery made by the robust type of people who inhabited this small Suffolk valley in the remote past can be visualized

But the discovery of what appears to be the remains—the basal portion—of one of their dwellings at the level of the lower floor introduces us to an even more intimate and interesting phase of their activities At the site where these remains have been found there exists a small terrace in the valley and the recent diggings have shown that the lower floor which rests upon yellow sand continues into the foot of this escarpment and is covered by a series of deposits averaging thirteen feet in thickness (Figure 2) The basal yellow sand is present in other parts of the valley and wherever it contains water it has in it numerous roots of trees *(Pinus sylvestris)* that flourished evidently on the ancient land surface represented by the lower floor

There is little doubt that this sand was dry when these trees which do not favor wet ground and are not now found in the valley were growing and the preservation of their roots is almost certainly due to the present water logged condition of the sand which has provided the favorable conditions necessary for the preservation of wood A quantity of these roots was found in the sand underlying the lower floor at the site of the recent diggings and in close association with the wooden structure here described



THE TWO OCCUPATION FLOORS

Figure 3 *An "occupation floor" is a stratum of soil formerly on the surface, containing lost or discarded objects*

This structure consists of two pieces of oak of plank like form, which overlap where they meet, and were placed with one of their longer edges buried superficially in and more or less vertical to the surface of the underlying sand (Figure 1)

The planks are about two feet long eight inches wide and one inch in thickness and, by their characteristic form were evidently split off a trunk of large size Behind these planks which may perhaps be likened to modern "base boards," were piled a quantity of flints, and other fairly large stones Beyond these, to hold the whole thing in position, is a row of stakes not closely set together, roughly pointed and driven into the sand to a depth of about one foot These stakes have most of their upper portions missing and were not inserted vertically, but inclined at an angle of about 45 degrees to the east

An Ancient Manufactory

Between the planks and the supporting mass of stones, were found traces of clay in which were partially embedded portions of numerous branches It is supposed that these branches, together with the missing upper portions of the stakes described, formerly extended for some distance above the planks, and afforded a shelter from the sun or wind

About opposite the middle of the shelter and in close contiguity to it, was found a heap of flints, some quartzite hammer stones, a large roughly made side scraper, a number of flint flakes and burnt flints, associated with blackened sand Here, it seems, was some sort of habitation where the manufacture of flint implements was carried on

It is possible that this structure is all that remains of the lower portion of a "wind screen"—such as was used by the primitive Australians and Tasma-

mians, and if so, the Ipswich discovery is unique in England. As the windward side of the shelter faced approximately northwest, this may be an indication of the direction of the prevailing winds of the days when it was in use.

The artifacts found in the shelter are in every way comparable with others discovered in the lower floor, where it has been exposed in other parts of the brick field, and there would seem little doubt that since this floor was occupied by man, the valley has been deepened by water action, and hill washes derived from the ancient deposits on either flank and of apparently different ages, have been laid down over the prehistoric land surface (Figure 6).

The wooden structure was found under deposits about five feet in depth and these strata appeared quite unbroken and without question, ran in under the adjacent terrace (Figure 2). Thus it does not seem possible to suppose that the wooden remains can be other than the same age as the lower floor. This would seem unquestionably to be of the period of the Stone Age, but the exact phase of the epoch that is represented is at present in dispute.

English archaeologists at the present time are much exercised as to whether the open air encampments of later Old Stone Age man, which were found in so many places in northern France by the late Professor Comment, occur in England. The former presence of hunters of these times in the caves of Derbyshire, South Wales, Cheddar, and Torquay is generally recognized as is the fact that these people must have progressed across the breadth of England in reaching these places and in all probability encamped in the open on their way.

UNCOVERING THE LOWER FLOOR

Figure 4. Looking north toward the escarpment. The lower floor is about 18 inches below the workman's feet

How Ancient Is the Find?

But, although a number of ancient floors or occupation levels have been discovered in eastern England, buried under certain superficial deposits which, judging from the general geological evidence would appear to have been laid down in later Old Stone Age times, yet a great divergence of opinion has made itself manifest as to whether these floors are referable to the latter epoch or to some hitherto unrecognized and early phase of the culminating period of the Stone Age—the Neolithic or New Stone Age.

The researches that have been carried out in Suffolk over a long stretch of years have established the fact that the latest glacial boulder clay (laid down by an ice sheet) of this area was deposited just after early Le Moustier—middle Old Stone Age—times, and it would be expected, therefore that the remains of the succeeding races of people who inhabited England would be found in the beds laid down immediately subsequent to the retreat of the ice which was responsible for this boulder clay. It is necessary to remember however that after this retreat, no drastic geological changes have taken place in Suffolk, and that the post boulder clay on the slopes of the now streamless valleys tributary to the main drainage system are as would be expected hill washes (the result of the slow wearing away of the slopes) of different kinds and ages (Figure 6).

The later Old Stone Age beds described by Comment are of the same nature and as England was joined to the Continent in those days they were no doubt laid down under very similar conditions. But the geologist can at present give no opinion as to the exact date of these English accumulations as being later in date than the latest boulder clay of East Anglia. He would class them simply as "geologically recent" or post glacial and there leave the matter.

The archaeologist, on the other hand is somewhat perturbed by the appearance in the floors that have been found of specimens of crude pottery such as have not yet been recorded from the later Old Stone Age deposits in the caves of France although there is good reason to believe that similar examples of the potter's art were unearthed some years ago in certain upper Le Moustier horizons (those of Neanderthal man) in one or two Belgian caverns.

In view therefore of these geological and archaeological difficulties, which will no doubt disappear as more discoveries are made, it is not possible to say with absolute certainty whether the ancient occupation levels found in Suffolk are to be referred to later Old Stone Age or to Neolithic times.

When uncovered the wood composing the remains of the ancient structure seemed to be in a very good state of preservation but it was soon found that it would not stand exposure to the air and it has been found necessary to keep it immersed in a suitable liquid in order to preserve it.

About fifteen yards to the west of where the discovery was made the remains of what appeared to be another shelter were found. But in this case only a portion of one of the supporting stakes and some small branches were recovered.

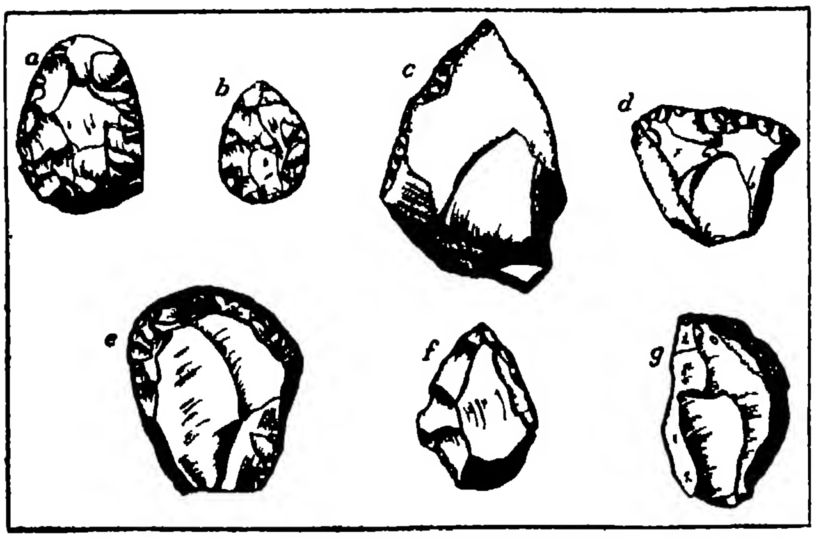
Judging by the large number of flints broken by extreme heat or cold at the level of the lower floor it seems that this period was marked by somewhat severe climatic conditions and these may have been the cause of the evacuation of the valley by the primitive inhabitants. When this happened their habitations would have gradually decayed and fallen down to be covered up by the sand and other material then being deposited in the valley (Figure 1). This deposition would cover up the old surface springs and cause much water logging of areas of the lower floor and there is no doubt that it was at such a place where the conditions were exceptionally favorable for the preservation of wood that the discovery of this remarkable structure has been made.

The valley in which the brickfield is situated is extraordinary rich in the remains of various races of prehistoric people and in addition contains a late Roman cemetery and other relics of this period.

The Work of Neanderthal Man?

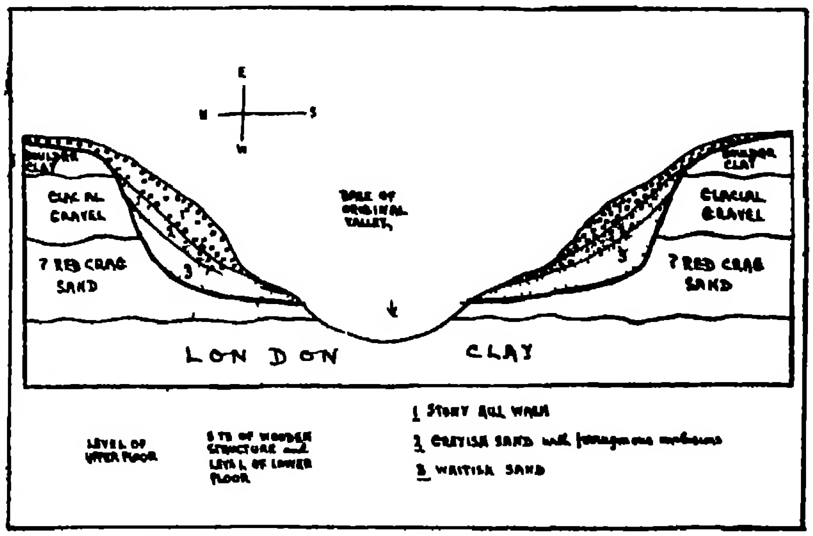
It is to be hoped that the further excavations now in progress will be successful in finding other examples of these ancient and important habitations of early man. By experiments which I have carried out I believe it possible that the wood found could have been shaped by a sharp flint and split off a trunk by means of stone wedges.

The opinion of the late Professor Commont was that the flint implements found at the level of the lower floor are to be referred to a phase of the upper Le Moustier or Mousterian (time of Neanderthal man) part of the Old Stone Age. This view is shared by many English archaeologists among whom I am to be numbered. It is possible, therefore that in this new discovery we see for the first time the remains of one of the wooden dwellings of later Old Stone Age times.



FLINT IMPLEMENTS FOUND IN OCCUPATION FLOORS

Figure 5. *a and b are hand axes, c and d are side scrapers, e is a large scraper, f is a point for boring and g is a knife having a more or less straight cutting edge*



THE VALLEY OF THE IMPORTANT DISCOVERY

Figure 6. *Diagrammatic cross section of the valley (not drawn to scale) showing the position of the wooden habitation and the level of the upper and lower floors*

Our Point of View

The Salvage of the S-51

WHEN the submarine *S-51* was so brutally cut down and sunk in 130 feet of water, it is probable that few people believed she would ever be raised and brought to a naval drydock. The spot where she was put down is open to the scend of the Atlantic seas and the uncertain weather which prevails at Block Island, 10 miles from whose shores the vessel was sunk. Furthermore, even should the wreck be lifted, there would be a voyage of about 140 miles to be undertaken before she could reach a suitable drydock. Yet, this most difficult task has been accomplished, and at the present writing the *S-51* rests in one of the drydocks of our most important Navy Yard.

It is probable that the major objects of the Navy Department in undertaking to recover the vessel, were, first, to bring home and give decent burial to the officers and men who went down with the ship, and secondly, to make a minute examination of the hull, and particularly of the enormous gash on her port side, so as to uncover the last shred of evidence whereby to determine at whose door the responsibility for the tragic loss of the ship and her crew is to be laid.

The salvage of the *S-51* is the most brilliant feat of its kind recorded in all the long history of the United States Navy, particularly when we bear in mind the great weight of the vessel of 1,000 tons or more and the fact that the lifting of the vessel by means of pontoons—always a delicate operation—had to be undertaken in waters that were rarely quiet and often decidedly rough. Great credit is due to Lieut-Commander Ellsberg and the officers and men who collaborated in this work. It is also pathetically gratifying to learn that the preliminary examination of the interior of the boat proved that the personnel of the *S 51* stayed at their posts during the few minutes which elapsed between the cutting down of the submarine and her plunge to the bottom. As we stood on the edge of the drydock and watched the falling waters uncover the great gash on the port side of the ship, it was evident from the infolding of the plating that the submarine was overridden from behind by a vessel overtaking her on the port side. Moreover, it was easy to see from the size of the hole that the enormous inrush of water, sweeping everything before it, must have overtaken the crew before they had time to close watertight doors or do anything to save either themselves or the ship.

Safeguarding Stored High Explosives

THE ever-present danger attending the storage of large quantities of high explosives in any one place was brought tragically to mind by the almost complete wiping out of the Navy's extensive arsenal near Dover, New Jersey. The Court of Inquiry which has been sitting will probably be able to determine definitely what was the cause of the disaster. That the explosion occurred during an extremely violent thunderstorm in which lightning was striking freely, renders it probable that a mass of high explosive was detonated by the shock of a heavy lightning bolt, or that it resulted from a fire in the storage building due to lightning. The deadly air wave resulting from the instantaneous generation of an enormous volume of gas at high pressure, swept the neighborhood clear of all obstructions, demolishing factory buildings, storehouses and the homes of the officers and men, to say nothing of the homes of private civilians.

A most impressive lesson of the disaster is the folly of allowing villages and isolated residences to spring up in close proximity to such an arsenal as that which was wrecked by this explosion. Wherever there is a large storage of high explosives—nitro-glycerine, T. N. T. or what not—a belt of the surrounding country, sufficiently wide for its extremities to be beyond the severely destructive effects of an explosion, should invariably be provided.

Passing of a Great Captain of Industry

IN the death of Charles Albert Coffin, industrial America loses one of its outstanding figures, for Mr. Coffin was President of the General Electric Company from its organization until June, 1913, when he was made Chairman of the Board—an office which he retained until 1922. The deceased was born in Somerset County, Maine—that state which has given to the country so many men who have achieved great distinction in the work of building up the industrial and commercial supremacy of the United States. Although he was not favored with much formal education in his early years, several colleges, including Yale, conferred upon him honorary degrees in recognition of the large part which he had played in the development of the electrical industry.

The great business ability which distinguished Mr. Coffin and the practical turn of his mind were coupled with an idealism which made him keenly alive to what might be called the humanitarian side of the electrical industry, as manifested in the lightening of labor and the increase of comfort throughout the community, alike in the factory and the home, in the city and on the farm. He was "gifted with a breadth of vision that enabled him to visualize business as something more than an opportunity to pay fair wages to workers and to earn fair profits for stockholders." One of his achievements was the organization of the Research Laboratory at Schenectady, whose able staff, down through the years, have made such notable contributions to our store of scientific knowledge. Four years ago, the General Electric Company established a fund of $400,000 to be known as the Charles A. Coffin Fund—the income of which is being used to encourage the study and application of the science of electricity—a lasting and appropriate memorial.

Truth About Great Lake Levels

Doubtless, many of the facts which are brought out in our article on the burning question of the Great Lake levels, as published on another page, will prove to be unexpected and indeed startling to most of our readers. This was to be expected, for a vast amount of misinformation has been deliberately written and broadcast about this intricate and very serious problem.

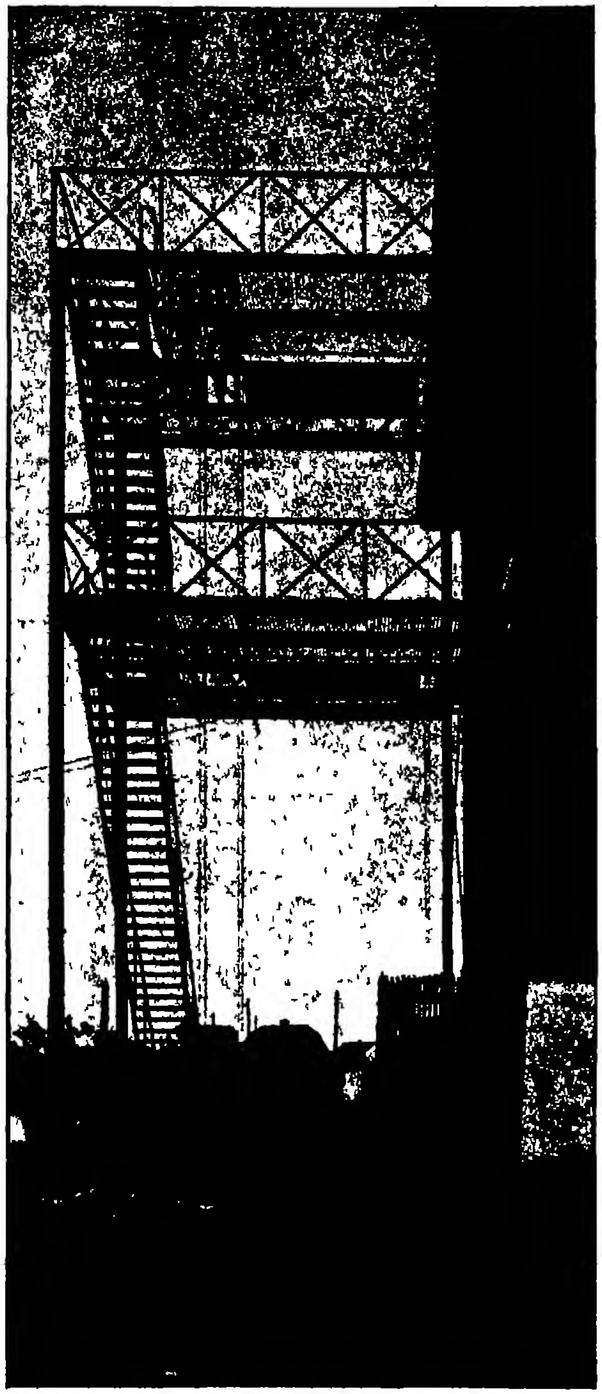
In view of the difficult and highly technical nature of this controversy, we decided, in response to the request of a leading citizen of Detroit, to visit the lake district and make a personal inspection on the spot. Through the courtesy of Secretary Hoover, the Corps of Engineers of the Army, the engineers of the Sanitary District of Chicago, and the head of the Weather Bureau in Washington, we were able to go over the official records, reports, letters, et cetera and discuss the question with the leading officials of these various bodies. It was surprising and gratifying to find that there is practically a unanimous agreement among the engineers of the Army, of the Sanitary District of Chicago, and of the Canadian engineers, as to the underlying facts of the case, and as to the methods, in their broad outline, by which the lake levels can be raised and permanently maintained.

Avoid Government Regulation

IN the present issue we close our discussion of the petroleum industry as forming part of the series on conservation. We have dwelt upon the extravagance of the past, the economical methods of the present, and the promise of the future. We have seen that ten percent of the gasoline production now comes from the gas which formerly was wasted into the air as a nuisance. We have seen that where once the gushing well found the operating crew unprepared and poured out millions of barrels, to waste away in crudely constructed reservoirs, today, the head of the well is capped, and both gas and oil are conducted, without waste, to gastight reservoirs. We have seen that by the new and remarkable system of cracking, it has been possible greatly to increase the yield of the valuable gasoline from a given quantity of crude oil. Lastly, we have drawn attention to the fact that efforts are being made to produce more economical motors and supply them with grades of anti-knock fuel suitable to their effective operation—this last development alone promising a larger saving of gasoline than all the other efforts combined.

The above facts are all to the good. But we have seen, also, that the great blot upon the industry is the mad rush to drive innumerable wells around one well that has struck oil. We have seen that there is no general plan or well thought out procedure in recovering the crude oil. Furthermore, all this wild effort to get the oil to the surface and sell it as quickly as possible is not only wasteful but has produced and still produces great irregularity in the oil industry. At one time, the market is flooded with oil, and there is a corresponding drop in price, and, what is worst of all, a foolish and wasteful use of the oil by the "joy-rider." This is followed by a slack period in which the oil industry shivers with apprehension lest there should be a positive shortage.

Now, the moral of all this is that there should be restricted, cooperative drilling of wells, and this thought brings us to the sentiment which heads this brief discussion. If drilling is to be regulated, it must be done by voluntary cooperation among the oil operators themselves. Failing that, the nation, panic stricken, is liable to demand government regulation of the industry. This would spell disaster! The oil operators—big and little—have done a wonderful job, even though, in the matter of unregulated drilling, they are at fault. But rather than have the government—which means the politician—attempt to regulate this vast industry, it would be better to let well enough alone, and allow the able and experienced men who have developed our marvelous oil industry to regulate themselves.



COMPLETE BED FIRE-ESCAPE

The device is built separate from the building It will still stand, even if the entire building collapses

AT THE TOP OF THE CONVEYOR

Here the patient's bed is placed on the endless chains, being held in position by extended handles that rest on rungs located at intervals on the chains The descent of the bed to ground level is controlled by means of a single brake mechanism

READY TO BE CARRIED OFF

The bed has been lowered by gravity to ground level and is here shown resting on the landing frame in a convenient position for removal to a safer location

Fire-escape for Bed-ridden Hospital Patients

Fire, which always inspires fear and panic when it starts in a building, is at its worst when it menaces those that are helpless In hospitals, the patients that are confined to bed are often at the entire mercy of the flames Beds are awkward to carry down flights of stairs and there are many records of hospital conflagrations where it was found impossible to remove the patients on the upper floors due to the stairway construction It was with these unfortunate victims in mind that the fire-escape system illustrated above was designed In essence, this system consists of specially con structed beds and a series of endless chains that extend from the highest floor to the ground. The beds are equipped with telescoping handles On the endless chains, there are horizontal rungs so arranged that the extended bed handles will rest upon them. When a fire occurs, the nurses or other attendants pull out the handles, roll or carry the bed and patient to the nearest fire-escape platform and place the bed in position on the bars A manually operated brake is then released and the bed is slowly lowered to the ground, its progress and speed being regulated by the brake. When it reaches the bottom, the bed rests on a substantial framework from which it is easily and quickly removed by other attendants, leaving the platform and frame ready to receive the next patient Throughout its operation, this system uses no motive power other than that of gravity With several of these fire-escapes on a hospital building, it will be almost impossible for patients to be cut off from escape by the progress of a fire Further more, after the beds are on the escape platform, the patients are compara tively safe, as even though the building should cave in, the fire escape framework will remain standing as it is a separate unit Thus, safety is offered to inmates of institutions where these fire-escapes are used

A Twenty-five Foot "Eye"

Astronomers Have Planned a Monster Telescope, Many Times Greater Than the Largest Now in Existence. Its Actual Construction Awaits the Necessary Funds. A 1600-Ton Marvel of Mechanical Precision

By Henry Norris Russell, Ph.D.
Professor of Astronomy, Princeton University
Research Associate of the Mt Wilson Observatory of the Carnegie Institution of Washington

WE considered last month some of the hopes and dreams of astronomers, but we left out one of the most important dreams of all—the dream of greater telescopes. We astronomers have great telescopes already; the greatest of all, the Hooker reflecting telescope of the Mt Wilson Observatory, with its hundred inches of clear diameter, and its hundred tons of delicately balanced moving metal—is but a few minutes walk from the spot where these lines are written. Why do we dream of more?

In the first place, every gain in telescopic power has brought with it the solution of problems that could not previously be cleared up. To take but a single instance, the hundred inch reflector shows what smaller instruments just cannot do with certainty—that the outer portions of the great spiral nebulae are composed of clouds of incalculable numbers of stars. What a still greater instrument might reveal in other nebulae, or the planets, and perhaps even on the moon, is tempting to think of.

Secondly, the astronomer is always eager to extend his studies and to test his theories by observations of all kinds upon the fainter stars—and in this pursuit he becomes accustomed to expose plates for many hours and even on many successive nights. With a greater telescope, collecting more light, these exposures would be far shorter. And by making longer ones he could get at still fainter stars—which are at present beyond reach.

Nor would the study of the brighter stars be unaffected. With more light, more powerful spectroscopes could be used, and we might get detailed knowledge more nearly comparable to what we have now concerning the sun.

But could a huge telescope, far exceeding anything that now exists, be built at all? A very definite answer to this question has just been given by Mr Pease whose extensive experience in connection with the design and construction of the hundred-inch telescope makes his judgment second to none. According to Mr Pease, "anything up to a telescope a hundred feet in aperture can be built, provided one wants to pay for it." In putting his dreams on paper, however, he has been more moderate and has made a serious and detailed study of the problems presented by a reflecting telescope three hundred inches—twenty five feet!—in aperture.

A Rare Combination

In 1672, Sir Isaac Newton presented to the Royal Society a little six-inch model of a new kind of telescope. Instead of being passed through a large lens, the light was to be reflected to a focus for a concave mirror. This was the first reflecting telescope ever made.

It is a long way from Newton's little telescope to the immense instrument shown on the opposite page.

Few realize adequately the nature of the problems involved in creating such a large piece of machinery—for a machine it is. Nor is the extremely minute criterion of accuracy demanded in the construction of the optical parts—nearly a millionth of an inch—fully sensed by all. A body weighing 1,600 tons must be mounted in such a manner that it can be moved with utmost ease, yet will maintain the most exacting geometrical relationship with its base. And the designer must not only understand mechanics but he must also know telescopes and astronomy. This is indeed a rare combination.

THE WORLD'S LARGEST TELESCOPE
The Hooker Telescope at Mt Wilson Observatory, with 100 inch mirror. It is sketched in to scale on the drawing on the opposite page

If the proposed instrument was as long in proportion to its breadth, as the present hundred-inch telescope, the tube would have to be 130 feet in length, but it would be practicable, and desirable, to give the mirror a deeper curvature, reducing the focal length to 1,000 inches, and making the skeleton tube of the instrument 86 feet long over all and 35 feet in outside diameter. Observations could be made, when desired, at the primary focus at the upper end of this long tube, but, in most instances, a secondary convex mirror, about 100 inches in diameter, would reflect the rays back to the lower end, giving an image on the scale which corresponds to an "equivalent focal length" of 200 feet.

Photographs taken with this arrangement would show images of the moon nearly two feet in diameter and of Jupiter more than half an inch across. Enlargement of the image to twice or three times the size, on the plates on which it was photographed, could easily be made by lenses acting after the fashion of the familiar telephoto combinations (as is already done with smaller instruments). The exposure times would still be short, and, under good atmospheric conditions, a wealth of detail might be photographed.

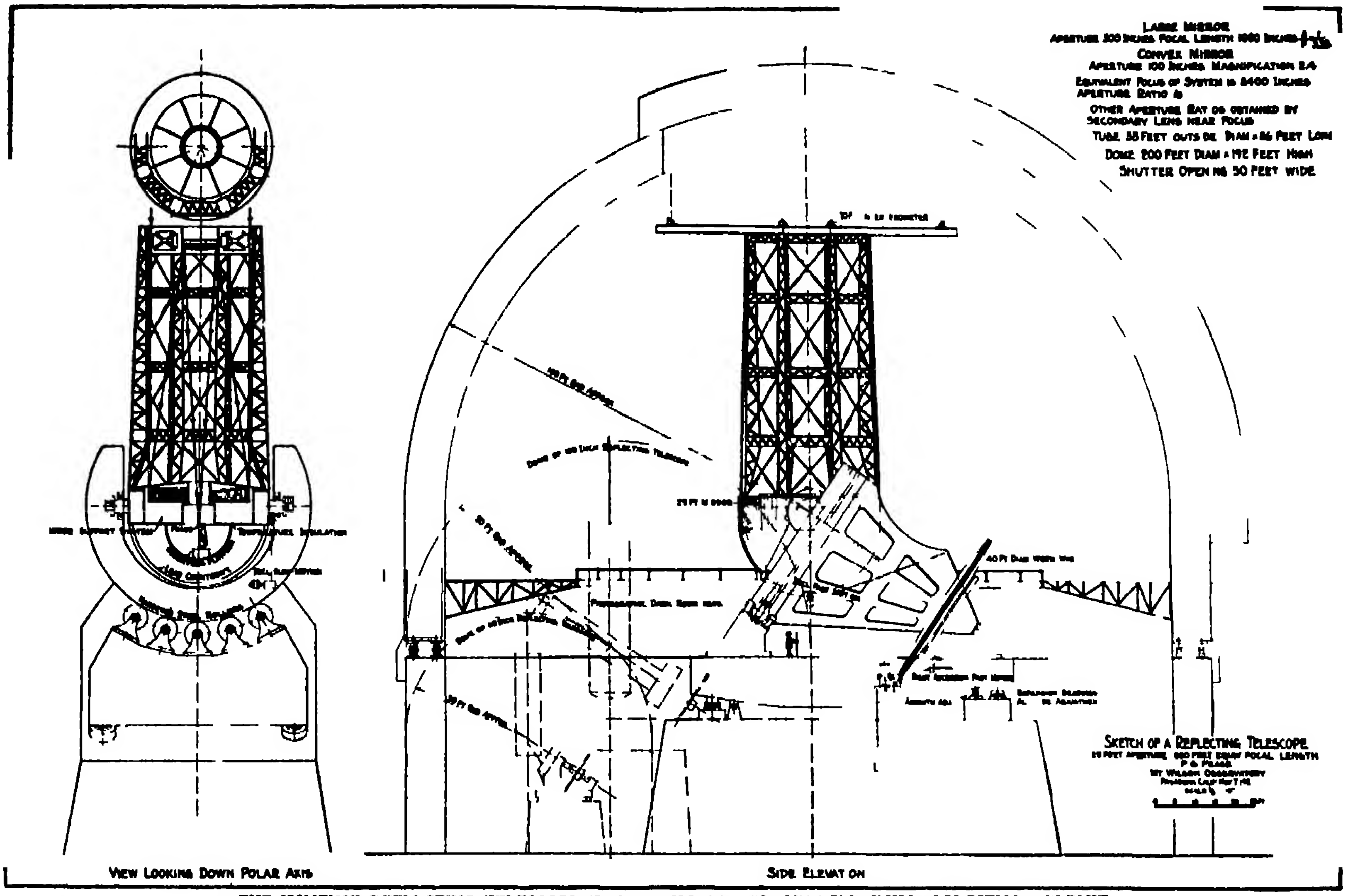
As is done in some of the largest existing telescopes, the light when it was used in a reflecting telescope having this "Cassegrain form" would pass through a hole in the center of the great mirror, and the observer would be stationed at the lower end of the telescope, looking up toward the sky.

Most of the work with the great telescopes is done by feeding the light collected by the big mirror to some auxiliary instrument—spectroscope, photometer, thermocouple for measuring heat, and the like. At the present time, even with the largest instrument, these auxiliary pieces of apparatus, which often weigh many hundreds of pounds, have to be attached to the telescope and removed to make room for others—a task which requires skill, care, often considerable physical effort, and always a good deal of time. The last item is not serious when the changes are made in the daytime, but it practically precludes the making of more than one kind of observation on a single night.

With the proposed telescope, these various instruments could all be permanently attached to the lower end—radiating outwards in various directions of the 35-foot circle, and a simple diagonal reflector would suffice to send the light out toward any one of them that might be chosen to work with. This would save a great deal of time and labor and an object of exceptional interest, such as a new star, could be observed in all sorts of ways on the same night.

With existing telescopes, too, the observer is carried on an "observing platform" of one sort or an other, which can be shifted from place to place as the telescope turns to follow the stars—and even so, he is sometimes forced into decidedly inconvenient positions. The new telescope would be so huge that the weight of a man—or of two or three—at the lower end would not disturb its running at all. The observer would therefore be carried on the telescope itself—in some sort of seat at the middle of the lower end, requiring only relatively simple ad

BUILDING THE HOOKER TELESCOPE, 1916
Lowering a ten-ton side of the yoke into place. Even this giant telescope would be dwarfed by the one proposed in this article



THE IMMENSE REFLECTING TELESCOPE WHICH WILL BE CONSTRUCTED WHEN CONDITIONS PERMIT

The mounting is of the equatorial ring type which is known to be particularly stable. Two axes at right angles to one another permit the telescope to be directed at all visible parts of the heaven. The mounting is of the Cassegrain type in which the 25-foot mirror reflects th[illegible] upward t[illegible] hyp[illegible] bol[illegible] h[illegible] fl[illegible] th[illegible] through a hole in the large mirror to a focu[illegible]

justments to meet the varying angles which the telescope axis made with the vertical. Even if he were working at the upper end he could find a seat in some sort of "cage" fixed on the middle of the upper end of the tube, around the plate holder which, although giving him room to move about, would block off but a negligible portion of the light received by the huge mirror.

The systems of electrical control by which the existing great telescopes can be manipulated by the observer, merely by pressing buttons, would work equally well in the new case, so that the observer could remain in his station, actually "aboard" the telescope, for hours at a time, shifting the dome as occasion demanded, adjusting the focus, and carrying on all the delicate "guiding" which keeps the star images exactly in the desired place. From this point of view, the proposed telescope, despite its vast dimensions, would be more convenient to run than a small one which is light enough to be moved by hand, and it would be a luxury for the astronomer to operate it.

The mechanical and optical design of a great telescope involves only the use of well established and tested principles. As Mr. Pease's drawing shows, the main tube would be mounted in a great, forked polar axis, in such a way that it could be pointed to any spot on the visible heavens. The whole weight of the moving parts would be 1,600 tons. Modern roller bearings are known to be capable of handling even such heavy loads, and the necessary precision of running could doubtless be attained by careful construction. The optical parts, too, involve no uncertain innovations.

For so large an aperture, only a mirror could be considered at all—the construction of a lens being utterly out of the question. Mr. Pease, in a paper recently presented before the Astronomical Society of the Pacific, upon which the present account is based—gives a very interesting survey of the different materials out of which a mirror might imaginably be made and concludes that a disk of glass would be the best according to our present knowledge. Metallic alloys, although hopeful, do not appear to be as good. Fused quartz, if it could be made in so great a size, would be best of all, for it expands very much less for a given rise of temperature and so would change its shape much less if the temperature in the dome rose. Next to this in desirability, and at present within the range of the practicable come the glasses of high silica content, like the familiar Pyrex, which expands much less than ordinary glass.

Estimated Cost—Twelve Million Dollars

The dome enclosing the great telescope would have to be 200 feet in diameter and 200 feet high, twice the size of that of the hundred-inch Hooker telescope, but here again the engineering problems are not unreasonably troublesome.

One of the most important of the scientific problems connected with such a telescope remains—its location. It would doubtless be used for a century at the very least, and many considerations have to be borne in mind—clear skies and steady air first of all—then healthy and tolerable living conditions for the observing staff, accessibility of engineering and machine shop aid and, last but not least, stability both of the material foundation against possible earthquakes and of the governmental environment against possible wars or revolutions!

A good many sites would however meet the conditions named above fairly well or better. From the purely astronomical standpoint a location in the southern hemisphere would be decidedly preferable, as the most interesting region in the whole heavens, including the Magellanic Clouds and the great star clouds of the Southern Milky Way—would then be accessible.

One more factor remains—counting the cost. Mr. Pease estimates on the basis of present prices that the great telescope with dome and accessories would cost some twelve millions of dollars. This is certainly a great sum, but the half million which has actually been spent on the hundred-inch telescope would have seemed equally impossible of attainment a generation or two ago. The investment from the standpoint of science would be a permanent one and bring in large dividends of increased knowledge. The state of private benefactions has grown to such a degree that such a royal gift is not inconceivable.

One is tempted to reflect, too, that could some future conference of the powers see its way to some mutual international agreement involving the construction of one less battleship all around and could this saving be devoted to science, we might see one such great telescope in the United States in some good climate in the southwest—another on British soil, perhaps in South Africa, and a third perchance in French Algeria.

But this dream is taking on a political turn and it is time to awake.

All photographs courtesy Westinghouse Electric and Manufacturing Company

AT PIT RIVER, ONE END OF THE LINE

This apparatus, at the power generating end of the test line suggests the thoroughness and intricacy of detail which entered into these short circuiting experiments

AT VACA, THE OPPOSITE TERMINAL

To record certain phases of the tests, new and special instruments, in many cases, were designed and constructed for use in different parts of the test circuits

A New Chapter in Electrical Engineering

Practical Experience Rather than Theoretical Reasoning Is the System that Has Been Found Most Satisfactory in the Development of Superpower

"READY at Vaca!"—"Ready at Pit River!"—"All right, Bill Let her go!" Whereupon Bill, pulling a long rope, connected a 220,000-volt transmission line directly to the ground.

There was a crash and a burst of flame 25 feet high Three thousand horsepower of electrical energy dissipated itself into heat and light Then the line's protective devices operated, and one of the most spectacular of electrical tests ever performed was over.

The point at issue was this—What happens to a long, high voltage transmission line when things go wrong?

Here was a question for which there was no satisfactory answer Small scale experiments, artificial lines, and other laboratory methods, although exceedingly useful in solving problems connected with transmission lines of ordinary length, had failed to provide data which checked with the results of actual experience in the case of very long lines

Back to Nature for an Answer

The answer had to be obtained, however, and the only way to get it was to "go back to nature" So a group of engineers decided to take a few chances and try some life sized tests.

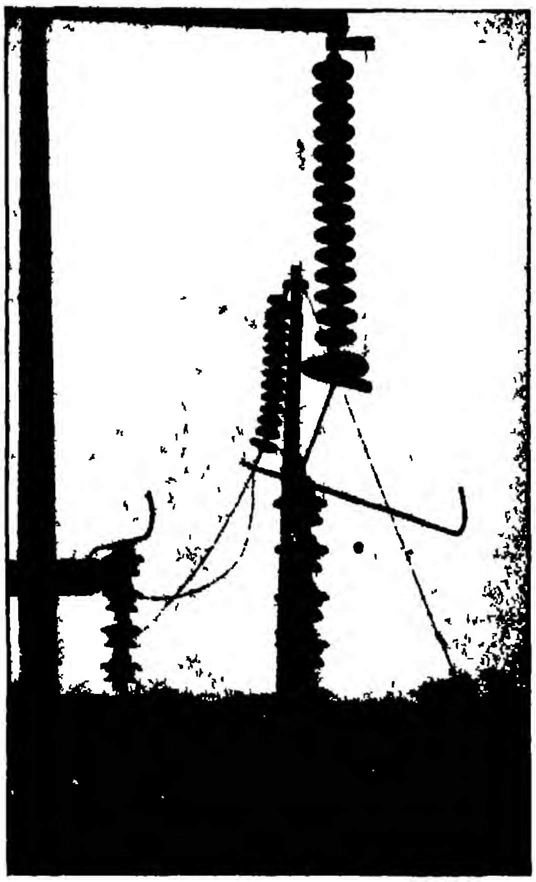
Dividing themselves into two groups, they installed themselves at either end of a 202 mile transmission line of the Pacific Gas and Electric Company in northern California. One group was in the Pit River hydro-electric power house, where two 35,000 kilovolt-ampere generators are in operation, and the other group was 202 miles away at Vaca Dixon, the point where the energy from the Pit River is poured into the general network of the power system The two groups worked together through the use of telephone communication carried by a high frequency carrier current over the transmission line itself

In order to reproduce various trouble conditions as closely as possible, a series of experiments was carried out with the generators, converters, circuit-breakers, and other machinery at both ends of the line Exact information as to what was going on in the system was secured by means of special instruments, many of which were designed for this particular occasion The most drastic test of all, the grounding of the line, was the "fireworks finish" in both the literal and the theatrical sense

The result of these experiments was a notable contribution to a new chapter of electrical engineering—"superpower engineering"—which is being prepared in cooperation with the public utilities and the electrical manufacturers

This new chapter is needed because many principles that hold good for electrical systems confined to restricted areas do not hold good in the case of long lines

Of these principles, perhaps the most familiar is that "the higher the voltage, the farther current can be economically transmitted" In ordinary practice, if 13,000 volts is not sufficient to carry a given amount of power economically a given distance, the desired results can be secured by raising the voltage to 22,000, 44,000 or some other value But when transmission lines are several hundred miles long, the rule is no longer necessarily true, and conditions may arise where no appreciable amount of power can be transmitted at any voltage.



SHORT-CIRCUITING DEVICE

Note the lengths of fuse wire across the insulators

Stability of Prime Importance

Let us take a line consisting of two insulated wires forming a transmission line about 700 miles long and let us apply, at one end an alternating voltage between the two wires by means of a generator of negligible reactance The applied voltage will not appear instantaneously at the other end, but will take an appreciable, though very short time (1/240th of a second) to arrive When this wave reaches the open end, it is reflected, producing a wave of the same magnitude but moving in the opposite direction, so that the voltage at the end of the line is doubled. This action is repeated again and again, with the result that within the small fraction of a second required for the operation of protective devices, the voltage may rise to upwards of 25 times its normal value Obviously, such a line (which is called "unstable") is useless for power transmission.

This fact has been known for a long time, but until recently, no one worried about it. As long as transmission lines did not exceed 100 miles in length, effects of this sort were considered negligible But now that distant waterpowers are being developed and long superpower lines are being run between systems, the situation has changed. The stability of long transmission lines has become a matter of prime importance.

This is especially true because a line connected to transformers and other common electrical devices begins to exhibit symptoms of instability at much shorter lengths than the simple line mentioned above.

The following description of an ordinary electrical accident may make this situation clear. Let us suppose a tree has fallen across a transmission line It will, of course, cause a ground which means that a sudden rush of current takes place. This

extra demand for power causes the machines on the power system to readjust themselves and in so doing, they set up power oscillations or "surges." In a line of ordinary length, protected by devices invented by many engineers, this surging is automatically suppressed, and after a few seconds of disturbance everything gets back to normal. But in long lines it may happen, due to certain instability effects, that the surges cannot be stopped in the ordinary manner, but grow rapidly worse and worse, until finally the whole system has to be shut down to prevent disaster. Then everything must be started up again, which takes time.

Similar surges can be started by lightning flashes, the sudden cutting off of a heavy load, and other more or less frequent occurrences, so that unless a line is thoroughly stable there will be frequent interruptions in the service. Hence, the necessity for the new science of superpower engineering.

Most people have a rather vague conception of the characteristics of a generator and their relation to the operation of the rest of an electrical system. It does not necessarily follow that the characteristics that give successful operation in a steam plant serving a congested area will be equally successful when used to serve the same area through a long transmission line.

The characteristics of the transmission line are determined when the distance of transmission, the spacing between the wires, the sizes of the conductors and the frequency are given. The amount of power that can be transmitted over a line of given length and characteristics, when the voltages at each end are absolutely fixed, is proportional to the product of these two voltages and this is the only way in which the voltages enter into the problem

The idea that a transmission line of any length may be operated up to the power limit determined by the carrying capacity of the conductors is a delusion In practically all transmission lines of any appreciable length, as built today, the operating limit of stability is reached long before the maximum carrying capacity of the conductors is approached.

On account of the large investment in a transmission line, it is imperative to find some way of increasing its operating limit and the work that has been done in the last few years has been carried on, first of all to determine the factors that enter into the problem and secondly, to determine what operating limit is possible, having due regard to the maintenance of a satisfactory standard of service.

"The fundamentals of superpower engineering have now been thoroughly explored," the writer was told by C. L. Fortescue, transmission engineer of the Westinghouse Company, who, with J. P. Jollyman and Roy Wilkins of the Pacific Gas and Electric Company, conducted the Vaca-Pit River tests. "There is now no theoretical limit to either the length or the capacity of a transmission line Effective measures to insure stability have been worked out, and although numerous details still remain to be perfected, operative transmission lines of any length needed in the United States can be constructed without difficulty.

Conservation a Driving Force

"All of the elements of an electric power system —the generating end, the transmission lines, and the load—affect the stability of the system, and each must have the proper characteristics in order that the system may remain stable under all conditions To determine these characteristics, a careful study is made of each element In the case of new construction, such as a generating plant or transmission line, the apparatus can be designed with the desired characteristics. The load, however, cannot ordinarily be altered and in many cases existing power houses are interconnected. Under such circumstances compensating devices of various kinds are installed.

"The generators and transmission lines for the hydro-electric development now under way at Conowingo, Maryland, which will supply 550,000 horsepower to the Philadelphia Electric Company, have been designed after a thorough investigation of the Philadelphia load to insure stability, and all other power installations, such as that proposed on the St Lawrence River, will also be analyzed and designed from this same standpoint

"The question of stability is constantly growing in importance because we are evidently entering into an era of long transmission lines of heavy capacity.

"There has been considerable misconception on this point, even among engineers According to the prevalent idea, superpower means chiefly a balancing of systems, with the interconnecting lines carrying only the small volume of differential power. This is true enough under most conditions, but it must not be forgotten that one of the great advantages of superpower is the ability to secure power from a neighbor in case of an emergency. In other words, unless the lines interconnecting the different systems are able to carry sufficient power to compensate for the temporary shutting down of the largest station of interconnected companies, the full benefits of the arrangement may be lost when most needed. In general, therefore, interconnections between large utilities cannot be justified unless they can deliver a large quota of power

"In addition, due to the increasing necessity of conserving fuel, we will develop more and more of our waterpowers, but unfortunately, nature works at cross purposes with the engineer in this connection. On one hand, she has made the sea coast, lakeside, and river bank the most attractive abiding place for the majority of people, and on the other she has located most waterpowers at considerable distances inland, and often in regions of naturally sparse population Hence, power from water falls must ordinarily be transmitted considerable distances to be used to the best advantage

"Stability is of dominating importance in long transmission lines, but certain troubles occurring in short lines, which have heretofore been referred to other causes, are now known to be due to instability, so that our investigations into the larger aspects of this question have enabled us to improve ordinary service"

Superpower development is, therefore, not merely a matter of tying electric systems together by wires, but involves a new order of engineering and weighty financial considerations Transmission lines over 100 miles long cost many millions of dollars and obviously cannot be constructed unless they earn their cost and upkeep The superpower engineer is, however, working out all of these intricate problems and it is he who will in time make the superpower dream come true

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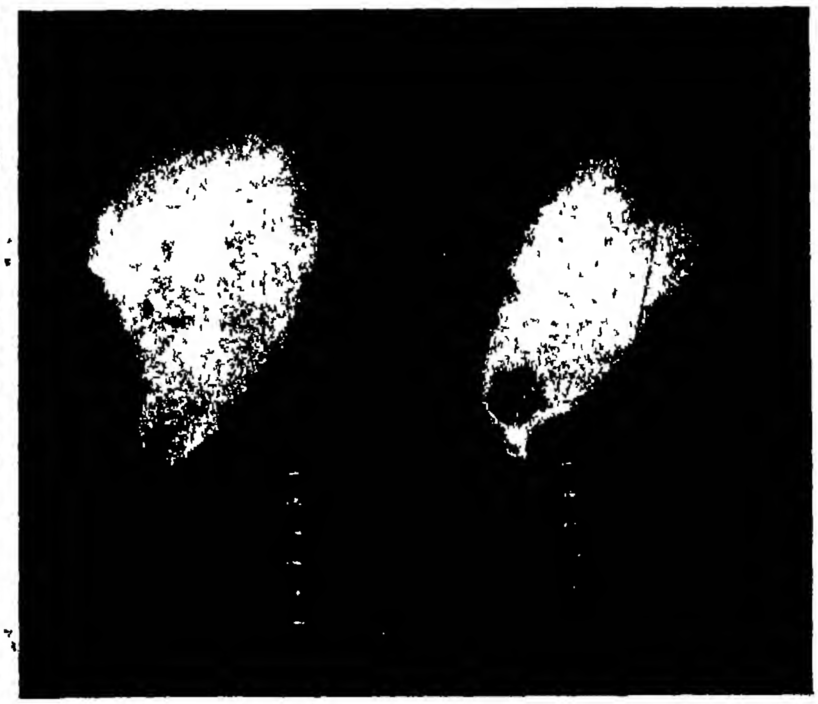
On the race tracks, new automobile refinements are tried out and if successful, they are used on pleasure cars Be sure to read of this in the thrilling article on racing automobiles that will appear in our October issue

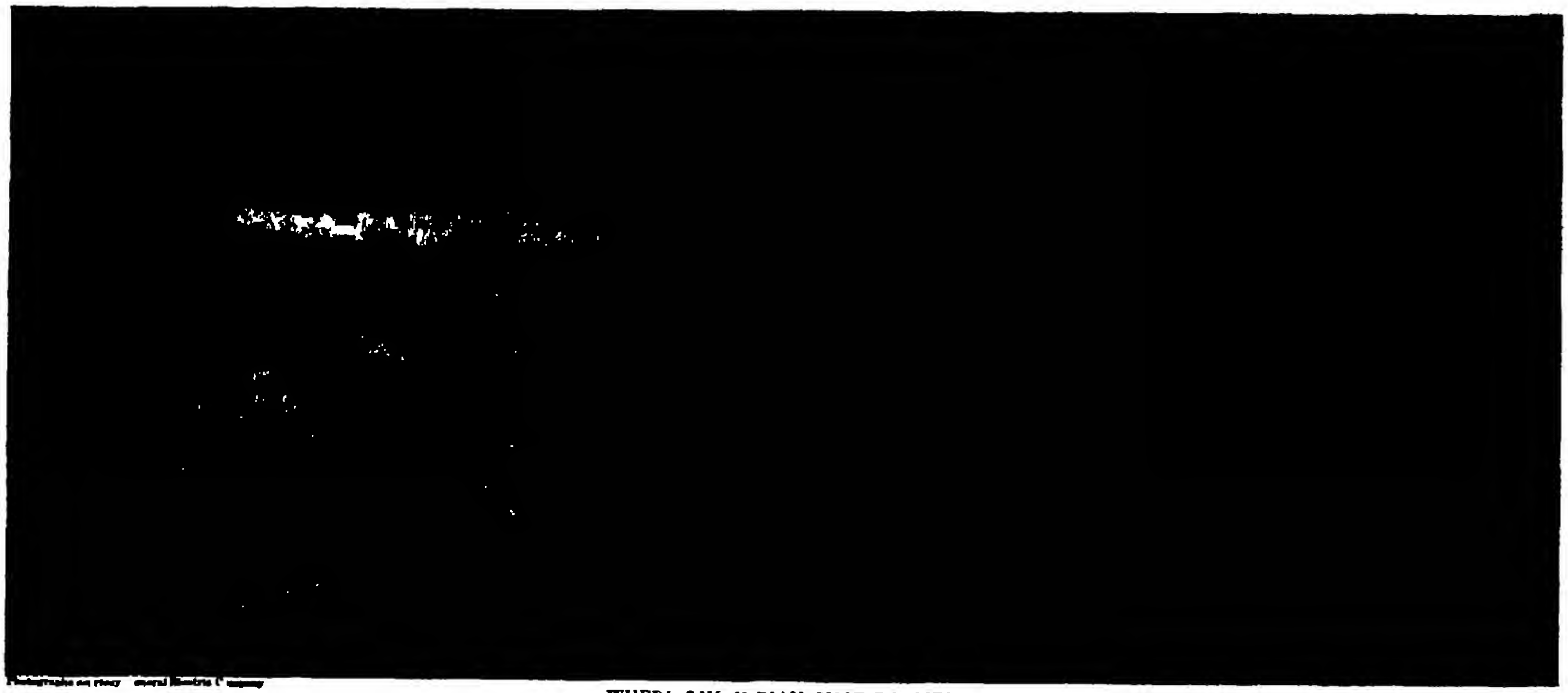
A VIEW OF THE FLASH

The short circuit is on The fuse wires across the insulators are being consumed by the enormous current flowing through the circuit at the moment



FROM ANOTHER ANGLE

Each man at the tests was so busy with his own work that few saw the actual flash that was recorded by cameras One of the resulting views is shown above



WHERE THE INDIAN ONCE ROAMED

Research problems involving various phases of radio are thrashed out on this 54-acre radio reservation of the General Electric Company at Schenectady New York. The parallel furrows show the ground system of the highpowered transmitter. The small buildings house the short wave stations

Acres of Radio

Invisible Waves Shot Into the Sky from the Mohawk Valley Recall the Indian's Curling Columns of Smoke

By Orrin E. Dunlap, Jr

IF the Red Men could wander down the long long trail from the Happy Hunting Grounds to the Mohawk Valley they would see instead of the wigwams of yore an array of poles and masts holding aloft a network of copper wires. There in the foothills of the Adirondacks on the level plains of South Schenectady stand seven powerful broadcasting stations scattered over a 54-acre plot. In place of the smoke messages of the Indian curling slowly into space, are invisible but powerful electric waves which carry dispatches, music and voice across world wide distances to Australia, South Africa and distant lands in Europe at the speed of sunlight.

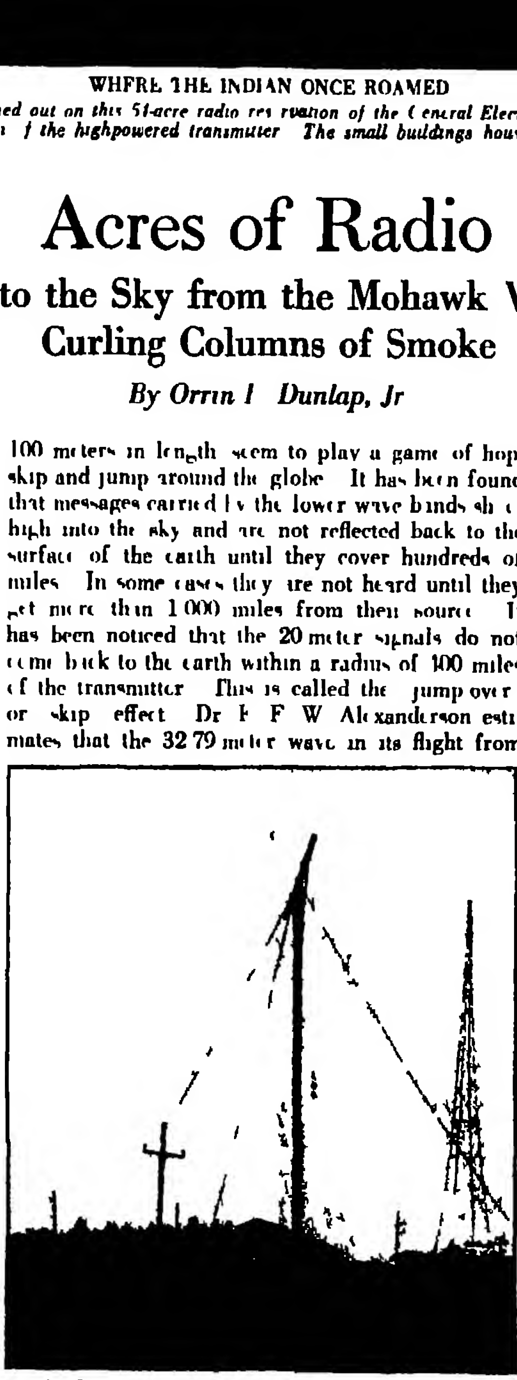
Short Waves Play Odd Pranks

This acreage dotted with tiny wooden shacks, which house the latest in radio transmitters, is the development laboratory of the General Electric research engineers who are studying the vagaries of the ether and transmission phenomenon on wave lengths from five to three thousand meters in length.

The seven transmitters can be operated simultaneously without the slightest interference with each other. A United States Navy band in Washington may be playing from one aerial, a dance orchestra on Broadway from another while a variety of songs or talks are radiated from the other wires some to come back as letters seeking verification of reception in different quarters of the globe. Such is the transformation that has taken place in communication since the Indians vanished from the Mohawk Valley.

The engineers by observing the various wave lengths and in reading the reports sent in by listeners are rapidly learning the tricks that radio plays upon the white man. The short waves, under 100 meters in length seem to play a game of hop skip and jump around the globe. It has been found that messages carried by the lower wave bands shoot high into the sky and are not reflected back to the surface of the earth until they cover hundreds of miles. In some cases they are not heard until they get more than 1,000 miles from their source. It has been noticed that the 20 meter signals do not come back to the earth within a radius of 100 miles of the transmitter. This is called the "jump over" or skip effect. Dr E F W Alexanderson estimates that the 32.79 meter wave in its flight from Schenectady to Australia makes approximately three skips.

The layman in observing the wire network over this research field might select the 300 foot steel towers as the aerial supports responsible for girdling Mother Earth with radio music but such an assumption would be wrong. Off in one corner of the radio reservation is an insignificant looking single length of wire 50 feet long and about the diameter of a lead pencil, suspended from an insulator hung by a rope from the yardarm atop a 70 foot telephone pole. This is the international contact!



2XAF's AERIAL CONTACT WITH AUSTRALIA

This is the so-called half wave type of antenna that has been found efficient for short wave transmission

Schenectady to South Africa

This wire is called a vertical half wave aerial. In the exact center is hung an aerial ammeter which measures the amount of current flowing in the wire. It is a trifle too high to be read directly with the unaided eye so the operator takes the reading through a telescope.

Nearby is another aerial of similar design but stretched in the horizontal direction. It is called a "horizontal half wave antenna." Certain localities get the messages more satisfactorily from the horizontal wire than from the vertical aerial. For example, Key West obtains more reliable signals on 32.79 meters radiated from the horizontal wire and there are indications that this wire is superior for north and south communication. However, California observers notice no difference between the vertical and horizontal wire. England gets best results when the vertical wire is used.

Another peculiarity is that the short wave transmitters require no ground connection. Installations tuned to radiate above 65 meters usually employ a counterpoise, but it is not needed on the lower channels. The big 50 kilowatt transmitter has a grid of wires buried in furrows beneath the aerial.

TUNING CAGES OF A SHORT WAVE AERIAL

The small inductances are for the purpose of regulating the transmitter's wavelength The meter denotes the amount of current in the antenna circuit

The high power, water cooled, vacuum tube transmitters which feed the aerial of the 32 79 meter system are rated at 20 kilowatts These tubes operate in a push pull circuit They are controlled by a quartz crystal oscillator through an intermediate, harmonic amplifier which holds the station on its exact wavelength The transmitter feeds approximately 13 kilowatts into the aerial

So far do the signals from the short wave transmitters travel, that it is difficult to determine which direction or route, the waves take in their trip to foreign countries One day at 5 30 PM, eastern standard time a greeting from Secretary of Agriculture W M Jardine to the annual agricultural show in South Africa was radiated by station 2XAF from the 32 79 meter transmitter The waves were detected by an amateur in Johannesburg 8 500 miles from Schenectady, and he forwarded the electrical impulses from his receiver over land wires to station JB Johannesburg, whence the American message was rebroadcast successfully to thousands of listeners

Several weeks later, mail was received from Victoria Australia, from an eavesdropper on the message destined for the farmers in South Africa. The letter said, "Very loud three hours after sunrise If signal went east it covered 14,000 miles and if west about 11,000 miles"

Harry Sadenwater, who was operator on the United States Navy seaplane *NC 1* during the trans atlantic flight in 1919, and who is now engineer in charge of technical operations of WGY KOA and KGO said, "There is no way of estimating which way the messages travel to reach Australia They may go via the north or south poles as far as we know"

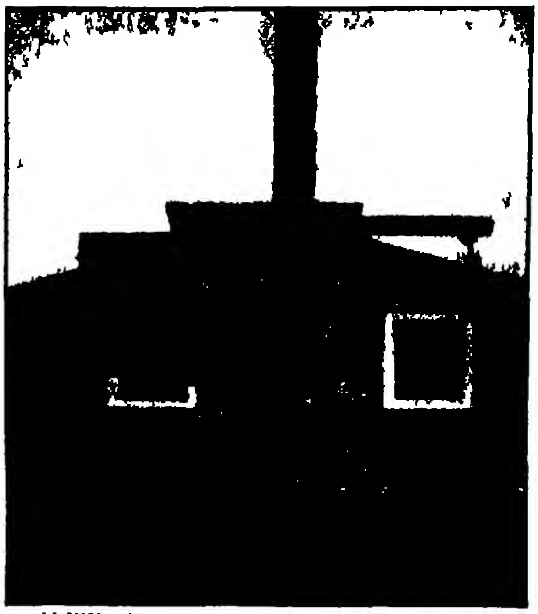
Mr Sadenwater called attention to the fact that wireless code signals are about four times as reliable as voice or music when sent over long distances because the dots and dashes are of comparatively uniform strength, while the different sounds in speech and music vary in intensity, some loud and others soft

Dotted across the 54-acre field are the following broadcasting plants WGY on 380 meters rated at 50 kilowatts (This is the station broadcast listeners hear), station 2XAH 10 kilowatts on 1 500 meters used for relaying programs to WCAD, Canton, New York, for rebroadcasting station 2XK, 10 kilowatts on 109 or 65 1 meters 2XAF 10 kilowatts on 32 79 meters 2XAW 600 watts on 15 meters 2XAC, 10 kilowatts on 50 2 meters for horizontal loop experiments, and 2XAD, 1 kilowatt on 26 4 meters

Wood Used for Insulation

One brick building 60 by 100 feet serves as the power house and home of the 50 kilowatt installation The other transmitters are housed in wooden buildings about 25 feet square There are three steel masts arranged in the form of a triangle so that various types of aerials can be tested Three 80 foot wooden poles support the aerial of the 109 meter equipment Other wooden masts hold aloft the aerials of the other short wave radio transmitting stations

The power building houses the high voltage rectifiers amplifying and modulating equipment There are three rectifiers having a capacity of 150 kilowatts at 15 000 volts These rectifiers convert the alternating current supplied to the station into direct current, which is used for the plate supply on the various transmitters The modulating equipment is arranged so that it can be connected with any of the smaller buildings by means of overhead transmission wires When the experimental stations radiate programs from the WGY studio in the city they are sent over two miles of aerial cable which connects the microphone with the transmitters and allows perfect retransmission



TUNING HOUSE OF A SHORT WAVE STATION

At this point the radio frequency feed lines from the transmitter are coupled through a tuned circuit to the short wave transmitting antenna system

A dark room is provided in the main building for developing oscillograph films which record modulation A circulating pump having a capacity of 150 gallons per minute supplies cooling water for the high power tubes The water is piped underground to all the radio shacks In the main building the water is forced by a blower at a pressure of 55 pounds per square inch through a large radiator similar to the radiator of an automobile thus keeping the temperature of the water at approximately 95 degrees Fahrenheit

The rubber hose carrying the water to the tubes and all of the electrical instruments which comprise the transmitters are mounted on maple The wooden frames have been given a special impregnating treatment to improve the insulating qualities so that as much of the electrical energy as possible will get into space just as the Indian smoldered his fire to create more smoke for his signal system

A 65 METER RADIO VOICE

This unit of the gigantic radio system at Schenectady New York operates on a wavelength of 65 meters The crystal control oscillator at the left serves to hold the station on its exact wave and so prevent swinging as well as interference

SCHENECTADY'S GIANT BROADCASTER

This complete layout is rated at 50 kilowatts and has a large operating radius When the transmitter is functioning the operator cannot approach the instruments to read the meters and so he must employ a telescope for this purpose

Casing-Head Gas Compression Plant Where Gasoline Is Obtained from Oil Well Gas

Uncle Sam, Spendthrift—IV

Conservation of Gasoline by Its Recovery from Gas; by Improved Refining Methods; and by Using Special Anti-Knock Gasoline in High-Speed Motors

By J. Bernard Walker

IN our preceding article on the conservation of petroleum (August issue) we dealt with the losses of petroleum due to the lack of organized scientific methods in drilling wells to get at the petroleum It was shown that there is a general consensus among the oil men that for every barrel of oil brought to the surface, four are left in the ground Inasmuch as the various proposed methods for bringing to the surface this 80 percent of the oil are at present largely experimental, and that such methods are being given only a very limited trial, it is not stretching a point too far to look upon this large residue of the oil as a waste or loss.

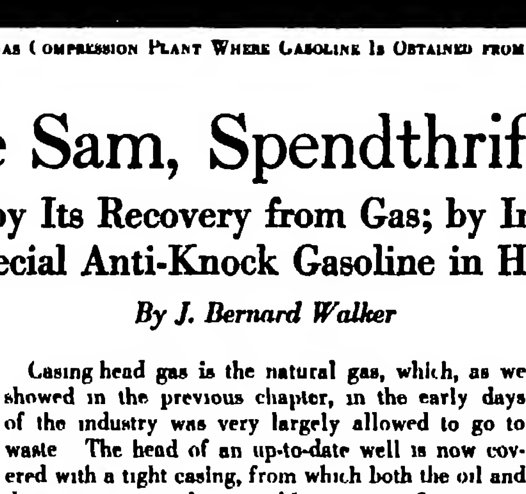
Furthermore, considering that we are merely skimming the cream of our oil reserves, and that we are using up this oil as fast as we get hold of it—living from hand to mouth—it cannot be denied that these discussions of the oil problem have a legitimate place under our title of "Uncle Sam, Spendthrift."

1,100,000,000 Gallons from Former Waste

In the present chapter, we deal with the wastes of oil above ground. At the outset it is only fair to state that, although in the earlier days of the industry the above ground wastes were enormous, today, thanks to a better understanding of the problem and the adoption of highly developed methods of refining, there is comparatively little waste here.

The most valuable constituent of the crude oil is gasoline. At the present time, the greater part of the gasoline is recovered by distillation, but of late years there has been an increasing development of a method of recovery known as "cracking," in which a larger percentage of the valuable contents of the oil is recovered than is possible by simple distillation. Furthermore, there is an increasing effort being made to recover what is known as "casing-head" gasoline, that is to say, the gasoline which is to be found in the gas which flows from an oil well.

Casing head gas is the natural gas, which, as we showed in the previous chapter, in the early days of the industry was very largely allowed to go to waste The head of an up-to-date well is now covered with a tight casing, from which both the oil and the gas are carried to suitable storage. In recovering the gasoline, two methods are used. In the first, the gas is compressed and led through water cooled coils, in which the gasoline is condensed and so recovered. In the other method, the gasoline is recovered by absorption—the gas being carried through various petroleum "fractions," ranging from heavy kerosene to light lubricating oils In some cases, the compression and absorption methods are combined The resulting gasoline is too volatile for use in motors and it must be blended with other gasoline before it can be placed upon the market



A RIVER OIL WELL

This one is located on a sand bar in the Arkansas River

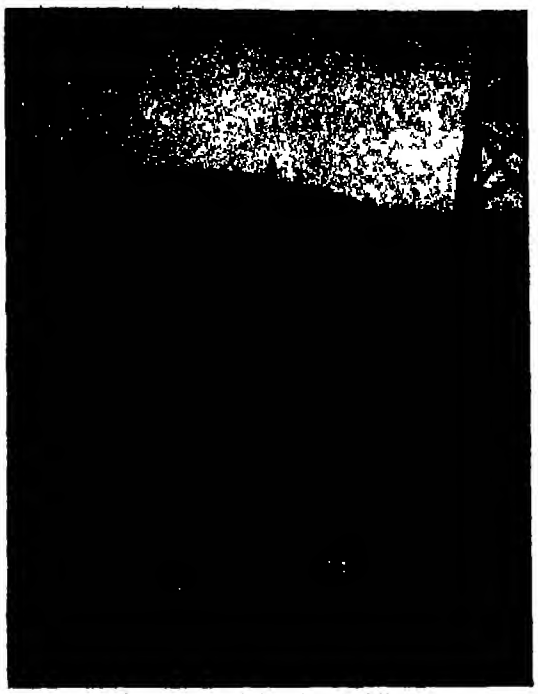
The recovery of casing head gasoline from oil-well gas must be put down as one of the most meritorious developments of modern day refining The production from what was formerly considered as a waste has grown from practically nothing in 1911 to over 1,100,000,000 gallons in 1925 According to the report of the American Petroleum Institute to which reference was made in a previous chapter, there has been a gradual increase in the amount of gasoline obtained from casing head gas, ranging from 0 2 of a gallon from gas to each barrel of oil produced in 1915 to approximately 1 4 gallons from gas to each barrel of oil produced in 1924.

Let us now consider the methods of recovery of gasoline from the oil itself, which is done in what are known as refineries The simplest of these are those plants which practice what is known as "topping" or "skimming."

"Cracking" Increases Gasoline Production

In topping, merely the gasoline is extracted—this being done by a process of distillation. A skimming plant extracts the gasoline and the kerosene. There are other refineries which carry the distillation further and remove such fractions as lubricating oils and other less-known products. A "complete" refinery is equipped to obtain any desired fraction from the crude oil handled and can, within certain limits, increase or decrease, at will, the ratios of the several products obtained, thereby adapting its operations to market conditions. The desire to increase the ratio of gasoline recovery led to the development of so-called "cracking" processes, which have added enormously to the total gasoline production.

In the distillation process, the oil is kept in circulation through a series of stills and during its progress is subjected to various and increasing degrees of heat—the different fractions being thrown



WELLS ON BOUNDARY LINE
These oil wells are located on the line between two adjacent oil properties in Los Angeles County, California

off, successively, as the oil is raised to their temperature of volatilization It will be understood that no chemical change takes place during this distillation

In the cracking process, the molecules of the oil are broken up by quick changes of temperature under pressure, and, by chemical action a larger percentage of gasoline is recovered than is possible by simple distillation. The work is done in large stills, towers, et cetera As in the case of the treatment of casing-head gas, there has been a steady growth in the use of the cracking process. The installation of a cracking plant calls for a large expenditure of capital, and consequently, the most extensive plants for the use of this process have been built by the large oil companies Today, the amount of gasoline recovered by the cracking process represents 26.5 percent of the total output of gasoline.

The president of the Standard Oil Company, during his testimony before the Federal Oil Conservation Board, stated, that, in his opinion, "cracking has doubled our potential gasoline resources," and no one can dispute his statement that the new method of treatment "has effected a conservation measure of incalculable value"

Before leaving this phase of the oil question, reference should be made to the rather frequent suggestion that, since fuel oil contains gasoline and other valuable oils, a restriction should be put upon its use for purposes which might just as well be served by coal. To this, the oil men answer that the question as to whether fuel oil should be used in furnaces or further reduced by cracking will be determined by the question of supply and demand and price As the price of the gasoline rises, proportionately large amounts of crude oil will be treated by the cracking process, and the users of fuel oil will return to coal when the higher price of gasoline justifies the change

In addition to the conservation of oil through the development of casing head gas and cracking processes, there remains one other most promising field of conservation, which may well prove to be the most important of all We refer to the development of special motor fuels and their use in a new type of high-compression, high-speed motor Of the many men who have directed their attention to this most important subject, none stand out so pre eminently as C. F Kettering, who now for many years past, as president of the General Motors Research Corporation, has been untiring in his search for what has come to be known as "anti knock" fuel During this investigation, he has made some 10,000 experiments in an endeavor to find out just what was the cause of "knock," and what are the desirable conditions, both in the fuel and in the motor, to get rid of this trouble

Motor and Oil Industries Must Cooperate

By the use of a gas-engine indicator, it was determined that knock is nothing more or less than detonation, that is to say, instead of the fuel burning gradually throughout the stroke of the piston, at some point during the stroke, detonation occurs, so that instead of a distributed pressure throughout this stroke, there is an increase of pressure, so rapid as to be somewhat similar to a blow of a sledge hammer upon the piston. Mr Kettering has this to say

"After a long series of tests, a certain type of straight run gasoline, plus 40 percent of benzol, represents a base line for this new type of anti-knock motor fuel" The same authority stated before the Federal Oil Conservation Board that "the motor industry has felt that it was not feasible for them to make any radical changes in motor design, unless they were assured of universal distribution of fuel of the type mentioned above, from which the gain to the public would far outweigh the cost to them" Later he says, "before the American public can have more efficient cars, it is necessary for the oil industry to standardize and to get a national distribution of fuels which are of high anti knock rating. It is safe to say that when this is done, the American public can expect a 20 to 40-percent increase in efficiency in their vehicles."

PREPARING FOR A "SHOT"
Pouring nitroglycerine into a shell that will be detonated at the bottom of the well to increase the oil flow

In all fairness to the oil industry, it should be stated that, when confronted with the above statement, they assert that, today, several of the larger oil companies are producing and marketing high-compression gasoline with the desired anti-knock properties, and that the record of the past renders it certain that such gasoline will be available in sufficient quantities

It is evident that the conservation of oil, when this shall have been accomplished, will be enormous. During the year 1925, over 9,000,000,000 gallons of gasoline were consumed in American cars A 20 to 40-percent increase of mileage per gallon would mean a saving per year of from two to four billion gallons of gasoline But since there are about 400,000 000 engine horsepower in the 20 million American cars of today, it is evident that the task of replacing the present motors with the new type can be accomplished only gradually.

¶ *The October chapter on conservation will deal with the mining of coal, pointing out the extravagant methods of the past, the improved practice of today, the coal reserves still in the ground, and the possible rate of their exhaustion.*

OIL GAS REMOVAL PLANT
These are gas traps where gas and oil are separated, gasoline is reclaimed from the gas

THE PURIFICATION OF GASOLINE
The four huge tanks are a battery of agitators used for purification at a Chicago plant

The Romance of the Norfolk Islanders

Modern Descendants of Mutineers Furnish Material for Research

By Dr. H. L. Shapiro

Pitcairn, once famous as the isolated Pacific island home of the mutineers of the *Bounty*, has become the center of scientific interest. The famous, or rather infamous, mutiny of the *Bounty* in 1789 took place in the Pacific and was followed by the settlement, on deserted and isolated Pitcairn Island, of some of the mutineers accompanied by their Tahitian wives. Forgotten by the world, the colony grew rapidly, after an initial series of murders. Rediscovered in 1808 by a Boston captain, the Pitcairn Islanders so impressed the whalers by the Arcadian simplicity and harmony of their peaceful lives that they became, in Victorian America and England, a source of text from which many sermons were preached. The increase of population forced the Pitcairn Islanders to migrate, in 1856, to Norfolk Island, 3,000 miles away. Their scientific interest is due to the fact that they are the offspring of a cross between representatives of two distinct racial groups. Practically everyone is related to everyone else on the island. It is fortunate that these descendants of the mutineers of the *Bounty* have been studied at the present time, since the proximity of Australia is rapidly changing these interesting people.

SCIENCE is not always as dry as dust It has, very often, its compensations in romance as thrilling as any tale of the high seas Even that famous crime of the Eighteenth Century, the mutiny of the *Bounty*, has in this, the Twentieth Century, offered material for scientific investigation The knowledge of this once famous mutiny and its sequel in the settlements on Pitcairn and Norfolk Islands is not widespread. But in the middle of the last century it was the subject of many pamphlets and lectures in England and in this country and was frequently cited as an example of Arcadian simplicity following crime and bloodshed, and of the ameliorating effect of Christianity

When the earliest voyagers to the South Seas returned to Europe, they had many things to tell, one of which was of the exotic bread fruit tree which served as the main source of food for many of the South Sea Islanders The fruit of this tree, when roasted, was said to taste very much like newly baked bread This easy source of food appealed to the imagination of the planters of the West Indies who petitioned His Majesty, King George III, to have these valuable plants carried to the West Indies to furnish sustenance for the plantation slaves This request was granted, and the *Bounty*, a ship of about 200 tons burden, was outfitted at Deptford, under the direction of Sir Joseph Banks of the Royal Academy, who had made a trip with Captain Cook to Tahiti and was familiar with the conditions there. In command was Lieutenant William Bligh, who also had been with Cook

The Mutineers Take Possession

In 1787 the *Bounty* sailed from England for Tahiti with a crew of forty-six including the two botanists assigned to the expedition Ten months later, in October, 1788, Bligh reached Tahiti where he intended to secure a large supply of bread fruit plants He then planned to proceed to the West Indies to deliver his cargo Tahiti proved particularly delightful to the sailors after a long sea voyage and the many hardships of nautical life in those times They reveled in the abundant supply of unaccustomed tropical fruits and the pleasures of social intercourse which they immediately established with the natives The white men were received with open arms, each having a "tyo" or native friend to look after his welfare The women, too, were hospitable and attractive Life must have seemed beneficent to these case hardened tars of the *Bounty* They were among the earliest of that long line of wanderers who have found the South Seas kind

After a stay of almost six months Bligh sailed from Tahiti, April 14, 1788, and made for the Tonga or Friendly Islands About two weeks later he was off Tofoa, one of the islands of that group, and with every assurance of a successful voyage On the night of April 27, Bligh retired, his "mind being entirely free from any suspicion" The watch had been divided into three parts, Fletcher Christian, the master's mate, having the morning watch from four to eight

Just before sunrise, Christian, who had been smarting under the insults of Bligh, was taken with the idea of seizing the ship He found several of the sailors who fell in with the plan It is said that, as a matter of fact, it was a sailor who originally suggested a mutiny to Christian At any rate, Christian and his confederates secured possession of the arms on board ship and entered the captain's cabin where they made Bligh a prisoner All the other officers were quelled before any attempt at resistance could be made Bligh tried to remonstrate against the mutiny, but he was ordered, "Hold your tongue, Sir, or you are dead this instant"

Bligh again pleaded with Christian, saying, "I'll pawn my honor, I'll give my bond, Mr Christian, never to think of this again, if you'll desist," and urged on behalf of his wife and family, to which Christian replied, "No, Captain Bligh, if you had any honor, things would not have come to this and if you had any regard for your wife and family, you should have thought of them before, and not behaved so much like a villian"

CAPTAIN BLIGH
The ill fated commander of the Bounty

In response to another entreaty by the captain, he answered, "It is too late, I have been in hell this fortnight past, and now I am determined to bear it no longer," and, turning to the boatswain, "and you know, Mr Cole, that I have been treated like a dog all the voyage"

Deaf to all appeals, Christian ordered the ship's boat lowered He put the captain and eighteen of the crew into her and set her adrift in an uncharted sea Bligh, with scanty provisions, in a boat dangerously low in the water, now made a voyage unparalleled in nautical history Among the Fiji Islands, then unknown, to North Queensland, through Torres Straits and finally to Timor, an island near Java, a total distance of 3,618 miles, Bligh for some forty days directed the course of his frail boat through storms and burning heat, in hunger and thirst, to reach his goal and set up a reputation for seamanship which has lasted to this day In spite of his personal character, which was, in certain respects harsh, he was an admirable and courageous navigator.

Ten Years of Unrestrained Crime

Christian, with the remainder of the crew amounting to twenty-five, sailed for Tubouai, near Tahiti, in order to found a colony. Meeting opposition from the natives, whose rights the sailors had outraged, he repaired to Tahiti where the mutineers divided, eight going with Christian, the others preferring to remain at Tahiti to await the passing of a rare ship Christian, who realized that if Bligh reached England, a man-of-war would be sent to recapture the mutineers, decided to make for an uninhabited island where he could escape the authorities. Accordingly he sailed for Pitcairn, which was then known to be deserted, having been discovered by a midshipman, a son of Major Pitcairn of Bunker Hill fame

The foresight of Christian in seeking a remote and inaccessible island proved to be well grounded, since on the return of Bligh to England, he aroused strong public opinion unfavorable to the mutineers. The British Admiralty sent an expedition under the command of Captain Edwards to capture the mutineers.

NORFOLK ISLAND
Norfolk is about 1,000 miles northeast of Sydney, and about 3,000 miles west of Pitcairn

Those who had remained at Tahiti were eventually taken by Captain Edwards in the *Pandora*, which was wrecked in Torres Straits, the straits that Bligh had negotiated successfully. Edwards had confined the prisoners in the infamous "Pandora's box," a small structure built on the deck of the *Pandora*. During the confusion incident to the wreck, the men confined in the box were forgotten until one of the crew freed some of the prisoners, but several went down. Edwards and the men who were saved from the wreck finally reached Timor and shipped for England where he delivered the mutineers. They stood trial, and three were hanged, three pardoned, and the others who had survived were declared not guilty in the plot.

Pitcairn is a small island, roughly 4½ miles in circumference, and only about 1½ miles at its greatest diameter. The climate is very equable, ranging from 65 degrees to 85 degrees. Physically, the island rises abruptly from the ocean and is girt with precipitous cliffs, which make landing a difficult and hazardous process, and for this reason, the islanders were free from the attentions of passing ships and consequent embarrassing questions.

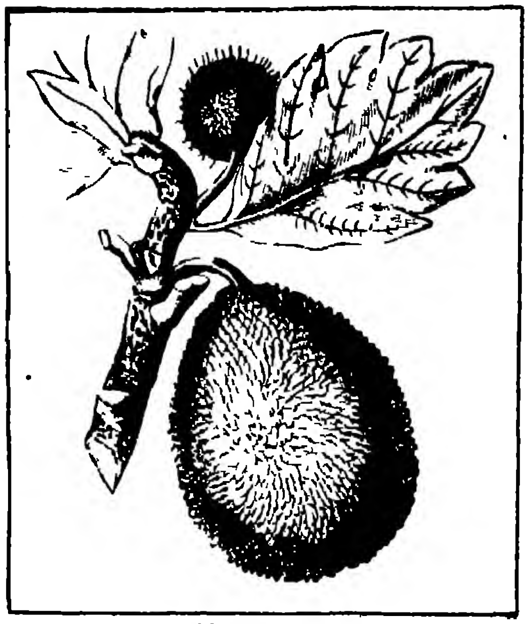
Christian and his party had taken twelve native women and six native men, and together they landed on Pitcairn where they destroyed the *Bounty*. From 1790, the year of their arrival at Pitcairn, until 1800 the island was the scene of horrible crimes. The native men, oppressed by their white masters, rebelled and killed several of the Englishmen. The white men with the aid of the Tahitian women retaliated by slaughtering the native men. Murders of indescribable brutality soon destroyed all but four of the Englishmen. Of the remaining men, McCoy drank himself to death from an intoxicating distillation of the Ti root plant, and Quintal was murdered by Young and Adams since he threatened the lives of these two. In 1800 Young died of asthma, leaving Adams alone with several women and about twenty children. From this source, the Norfolk Islanders of today have descended.

Dawn of a New Era

A new period now began in the history of this interesting colony. Adams, becoming aware of his responsibilities and perhaps from remorse for his part in the preceding butchery, undertook to teach the young children the elements of Christianity, and so well had he succeeded that when the colony was discovered in 1808 by Captain Mayhew Folger of Boston and in 1814 by Staines and Pipon, these men gave glowing accounts of the intense religious atmosphere on Pitcairn and the simplicity and beauty of the life of its inhabitants. From this time on many ships called at Pitcairn and all the observers of the descendants of the mutineers were unanimous in their unstinted praise of the islanders. Brodie, who spent two weeks on the island in 1850, writes:

"And thus ends my brief stay among the most simple, innocent, and affectionate people it was ever my lot to be thrown amongst. There is a charm in perfect innocence which he must be indeed hackneyed and hardened who cannot feel. Such a society, so free, not only from vice, but even from those petty bickerings and jealousies—those minor infirmities which we are accustomed to suppose are ingrained in human nature—can probably not be paralleled elsewhere. It is the realization of Arcadia, or what we had been accustomed to suppose had existence only in poetic imagination—the golden age, all living as one family, a commonwealth of brothers and sisters, which, indeed, by ties of relationship they actually are, the earth yielding abundantly, requiring only so much labor as suffices to support its occupants, and save them from the listlessness of inactivity. There is neither wealth nor want, but a primitive simplicity of life and manner, perfect equality in rank and station, and perfect content."

In 1856, the population having increased to about 190, the need for a larger island became imperative, and the entire colony was transported to Norfolk Island, a former penal settlement. In 1858 and again in 1863 several families returned to Pitcairn, but the main colony remained on Norfolk Island increasing to some 600, not including those who have migrated in recent years to New Zealand and Australia. The smaller group on Pitcairn now consists of 170 odd according to Sir Cecil Rodwell, who visited the island in 1921.



BREADFRUIT
A common source of food in Polynesia. The bread fruit was the object of Bligh's voyage

It can easily be seen from the above paragraphs that the mutiny of the *Bounty* and the fortunes of the descendants of the mutineers had a strong hold on the imagination of a former generation to whom the idyllic and religious character of these people appealed. We today have a scientific interest in the Pitcairn and Norfolk Islanders. These people represent a cross between English and Polynesian, two rather widely divergent stocks, whose characters are sufficiently contrasting to allow a study of the physical results of race mixture. In addition to this, the descendants of the mutineers have for several generations been inbreeding, in some cases, very closely. One has, therefore, in these people a problem in human genetics which offers alluring possibilities. Then, too, they have been isolated on islands off the beaten tracks of commerce, having had little contact with the debasing influences, both sociological and psychological, which practically all other mixed people have had to suffer. They are under no social stigma such as that under which the mulattoes of this country and the Eurasians of India labor, a fact which makes their significance in a study of race mixture all the more important.

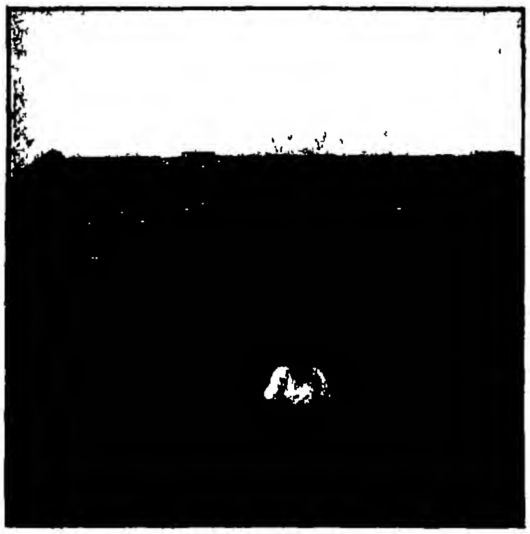
Fortunately I was enabled during part of the year 1923-24 to visit Norfolk Island as a Fellow of the

"UNCLE" CORNISH QUINTAL
Representing the second generation of descendants from the mutineers

NORFOLK ISLAND MAN
A common type of male to be found on Norfolk Island today

AN ISLAND GIRL
One of the few true blondes, a type recessive to the white strain

ANOTHER ISLAND GIRL
This type shows the predominance of the inherited Tahitian characters



A RELIC OF OLD NORFOLK

This house is one of the few remaining structures built in the days when Norfolk was a British penal colony

Bishop Museum and to make a study of the descendants of the mutineers, collecting data for an analysis of the genetic results of this cross between Tahitian women and English sailors. The island is situated on the extreme southern border of the tropics, about 1,000 miles northeast of Sydney, Australia. It is upward of twenty miles in circumference, being six miles at its greatest breadth. Resting on a submerged plateau and of volcanic origin, the island rises at its highest point to 1,000 feet above the sea. It is, however, for the most part, rolling park-like country with wide sweeps of open paddocks like lawns dotted with magnificent Norfolk Pines and frequently pierced with precipitous "gullies," at the bottoms of which flourish tall, damp banana trees in the midst of a typical jungle growth, all of which creates an illusion of a tropical swamp. Tall fern trees stand side by side with pines, and roses bloom in January. A long list, too tedious to recite in full, of exotic fruits grow luxuriously. Among these are the guava, passion fruit, custard apple, rose-apple, and paw-paw, besides many of the more common tropical fruits such as pineapple, orange and lemon.

In such surroundings the Norfolk Islanders live today, a more sophisticated people than they were in 1850. They have been so often represented as free from all the vices of more civilized races that it seems cruel to shatter such illusions, although the islanders themselves would be the last to claim such special characteristics. They have the passions and faults of other humans, but they still have, to a remarkable degree, a kindness of heart and hospitality which is refreshing. One feels a sheer joy in their giving, which unfortunately has to some extent been taken advantage of by a few tourists who are, however, in the minority. The religious tone which so impressed the early visitors is not so evident now, although the older folks still maintain their custom of frequent prayers and strict religious observances. But the young people pay less attention to religion than was formerly the case.

Physically, they are splendid examples of men and women, taller than either parent stock. They are, in the main, only slightly darker in complexion than a southern European, which darkness is due partly to constant exposure to the sun and partly to their Tahitian ancestresses. Some of the women, however, are as fair as the average American, and, indeed, there are even a few blondes who represent the recurrence of the English part of their ancestry. While most of the islanders have brown eyes, blue eyes are by no means uncommon.

Their Insularity Breaking Down

Farming is the principal industry, but they have had no success in the marketing of their products in Sydney, principally because of the distance to the mainland. Lemon juice was once and seems again likely to be a profitable source of income.

The most interesting and dangerous of their occupations is whaling, the mention of which brings me to a romantic phase of their history. Since the very early days of New Bedford whaling, the Pitcairn and later the Norfolk Islanders have had an intimate connection with the whalemen. For many years their principal trade was carried on with the whalers who frequently would stop and restock with fresh food and water. In the year 1846 as many as forty-six American ships touched at Pitcairn. But when the whaling from New Bedford declined, the islanders suffered because of lack of communication with the outside world and from a paucity of supplies, which they were accustomed to receive from the whalers in exchange for island products. Often a ship captain's wife would spend several months with the islanders to be picked up on the return trip, and from these visits the natives derived many of the old New England customs. Even to this day pie is still made in the New England manner.

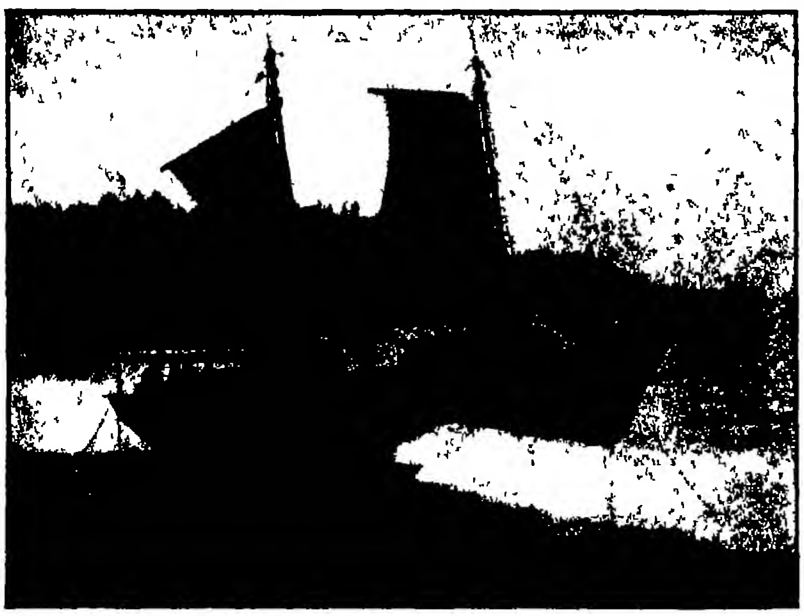
When I arrived at Norfolk, many of the older men, including Uncle Cornish, who later became my guide and mentor, discovering that I was from Boston, plied me questions about their old friends from New Bedford. "Did I know Captains Chase and Church and Tabor and Bunker?" and a host of other names connected with New Bedford whaling. Some of the older men shipped with whalers, taking cruises of three and four years and ranging from the Bay of Islands to Behring Sea. I was particularly fortunate to prevail upon one of the crews to allow me to accompany them on a whale hunt.

THE NEW METHODIST CHURCH

A recent photograph showing the Methodist congregation at the dedication of their new place of worship

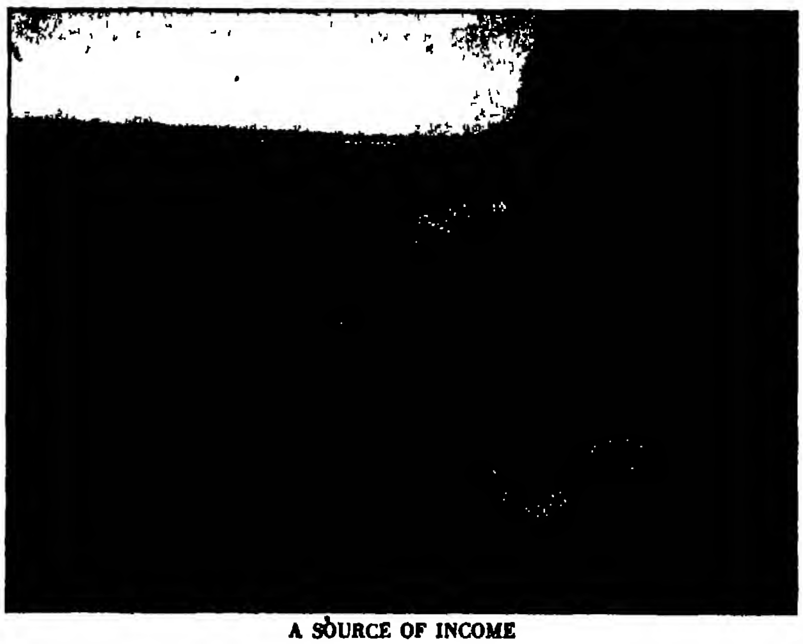
There are three whale-boats, about thirty feet long, on the island. Each of these is manned by a crew of six men and the whaling follows the best traditions of fifty and seventy-five years ago. There is the boat-steerer and the harpooner, who stands like the bronze statue in New Bedford, poised for the casting of the iron. The other four men pull on the oars or paddle as they approach the whale. The islanders are skillful boatmen and during the short season from July to September or October they manage, in a good run, to make a tidy bit in selling the whale oil.

Up to the present time the Norfolk Islanders have managed to maintain their insularity. But it seems that that will break down in the coming years, since the charm of the island is just beginning to attract visitors from Australia, and the opportunities in Sydney are very appealing to the young people who are increasingly leaving their island home.



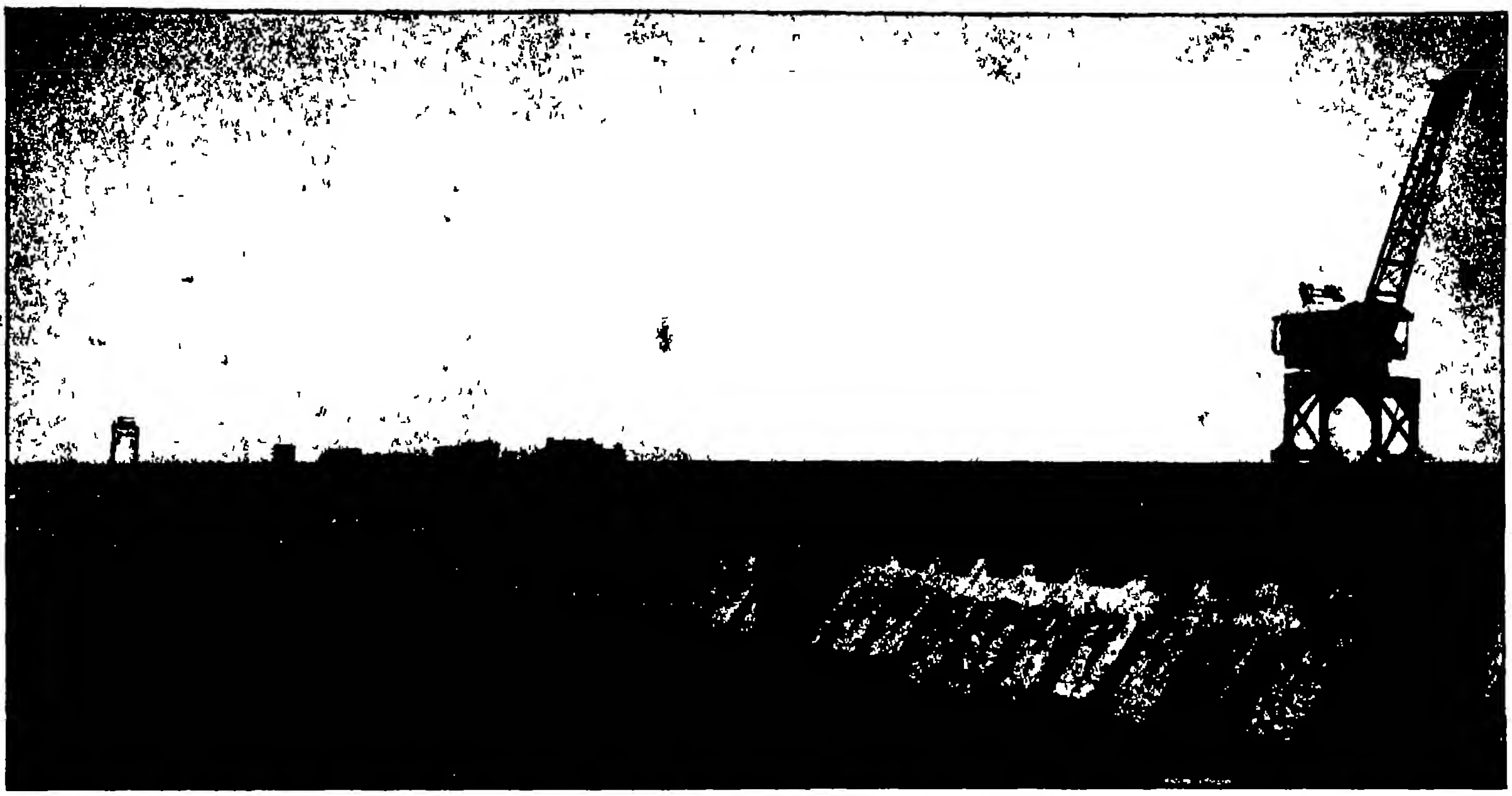
A RECENTLY COMPLETED BOAT

This was built by the Islanders for trading with New Zealand



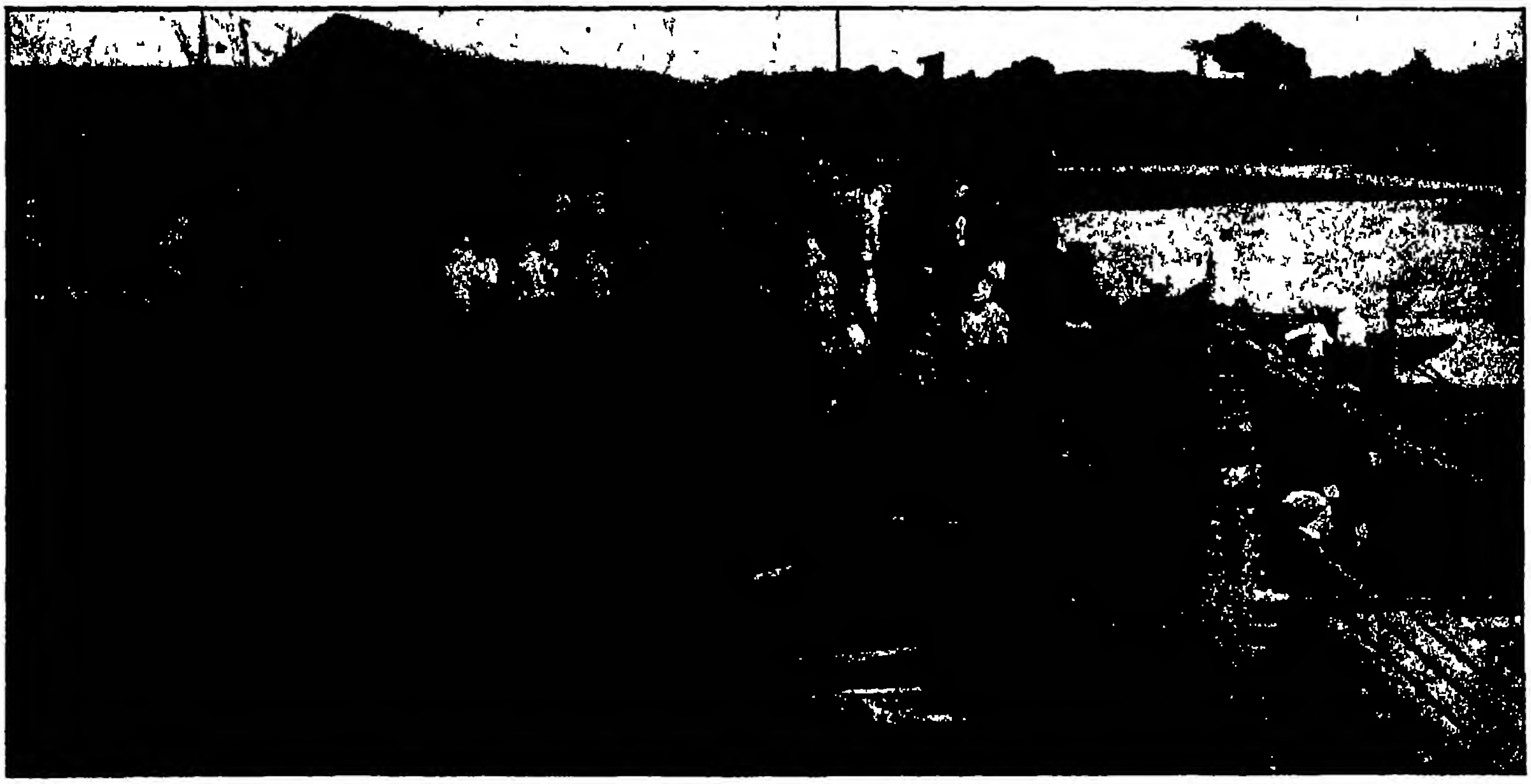
A SOURCE OF INCOME

Whaling is one of the industries of the Norfolk Islanders



AFRICAN DAM WILL MAKE COTTON GROWING POSSIBLE

The granite Sennar Dam, recently built by the British across the Blue Nile, 170 miles south of Khartum, to irrigate 3,000,000 acres. This structure is 2.23 miles long, 128 feet high above the foundations, and is pierced by 80 large sluices and an upper line of spillway sluices



CONTRACTOR'S SUPPLY RAILWAY ON BRIDGE OF BOATS

The dam was built in two sections—one at a time. One half of the river bed was laid by building a temporary "sudd" or dam and unwatering the enclosed area by pumping. Access to the work was by a bridge of boats as here shown

Reclaiming Three Million Acres of "Darkest Africa"

We are all familiar with the great dam which the British built at Assouan for the irrigation of the valley of the Lower Nile—a work which has been largely responsible for the present material prosperity of Egypt. A few years ago, they conceived the project of reclaiming, by irrigation, a vast plateau that lies between the two forks of the Nile. The surveys showed that, by the construction of a dam across the Blue Nile at Sennar, it would be possible to store sufficient water for the irrigation, ultimately, of 3,000,000 acres of fertile, cotton-producing land, and immediately of 300,000 acres. The task of building this granite structure has been successfully accomplished under the supervision of O. L. Prowde and his staff

A Distinctly New Rectifier

A Dry Metal Oxide Between Two Electrodes Makes a Rectifier that Presents a Wide Field for Interesting Experimental Work

By H H Sheldon, Ph D

Chairman of the Department of Physics Washington Square College New York University

SO many new types of rectifiers have made their appearance since alternating currents have been used and particularly since the advent of radio broadcasting that to call a rectifier distinctly new is likely to call forth a challenge. Such a challenge I am sure can be satisfactorily met in this case, at least until it is better understood when it may be possible to classify it under one of the existing heads such as mechanical, chemical, thermionic, photo electric, et cetera.

Building the Oxide Rectifier

Before discussing this rectifier however let us first get thoroughly in mind what a rectifier is intended to do. An alternating current is continually changing direction, rising to a maximum in one direction, falling to a maximum in the opposite direction and so on. Its fluctuations may be represented by a wavy line as shown in Figure 1 (a), the straight line through it indicating zero value of current. The purpose of a rectifier is to prevent the flow of a current in two directions by blocking it off in one direction or by changing one half of the wave so that both halves flow in the same direction according to the type and construction of the instrument used. If a rectifier were ideal and permitted no reverse current whatever the current obtained through the instrument when in series with a source of alternating current would be like that shown in Figure 1 (b). Here only half of the wave is used and we have a half wave rectifier. A full wave rectifier would turn the lower half of the wave up giving such a current as that shown in Figure 1 (c).

A convenient way of using this new rectifier as a full wave rectifier is shown in Figure 2. This requires that four of the rectifiers be arranged so that the normal current flows through them in the directions indicated by the arrows. If the surge is toward A then it goes through from A to D and returns through the branch CB. If the surge is toward B then it goes through B to D and returns through the branch CA. Thus, in either case the current through the useful circuit is always in the same direction and we have the type of rectification shown in Figure 1 (c). Since the average reader perhaps knows something about the problem of rectification through experience with crystal detectors such as galena as used in radio sets, or perhaps with the more recent devices used in "A" battery chargers or "B" battery eliminators, I shall describe this new rectifier with particular emphasis on how it differs from others now used, in construction and in its action.

> **A Chance for the Amateur**
>
> **In this article, Professor Sheldon presents some enlightening details on the construction of a new rectifier that will be of great interest to those of our readers who are experimentally inclined. The instrument holds great possibilities in the direction of the further development of "A" battery eliminators for use in connection with radio sets. If the amateur pursues an intelligent course of experimentation, who can prophesy the final results? Since this rectifier will operate on low voltages, one problem of battery elimination is solved. It only remains to develop a working system. Why should not one of our readers accomplish this?**

This rectifier, as described at a recent meeting of the American Physical Society by L O Grondahl, consists of a copper disk on which there is a layer of copper oxide. This oxide is formed right on the copper itself by heating the copper to a high temperature, the oxygen in the air will do the rest. Having done this one side of the copper should have the oxide cleaned off, an operation easily performed with a file or sand paper. Against the other side a similar sized disk of lead is placed and the two disks are bolted tightly together by means of an insulated three eighths inch bolt. Fibre washers under the nut and a fibre tube around the bolt would be most suitable as insulation, but several thicknesses of heavy paper will serve admirably if they are thick enough to resist tearing as the bolt is tightened. The whole unit as shown in Figure 3, is no larger than a watch. The sample rectifier exhibited at the American Physical Society was only 1½ inches in diameter.

Rectifies at Low Voltage

What will this rectifier do that others will not do? It will rectify a large current on a very little voltage, about three amperes on a volt and a half. For a rectifier of the diameter mentioned its resistance will depend upon the pressure applied by screwing down the bolt and may be as small as a fraction of an ohm. For a lower resistance and consequently a larger current washers of a larger area are used. This large current at low voltage is the particularly striking feature of this rectifier. Crystal detectors are useful only for negligible current at high voltage; the rectifiers used in B battery eliminators use a high voltage of two to four hundred volts and pass a current of about forty to eighty milliamperes, roughly. Hot filament rectifiers such as the Rectigon or Tungar rectifying tubes, while passing a large current of a few amperes, nevertheless have the disadvantage of requiring current to heat the electron emitting filament. This greatly cuts down the efficiency. The new device does away with all of this loss, and is simple and extremely cheap to construct.

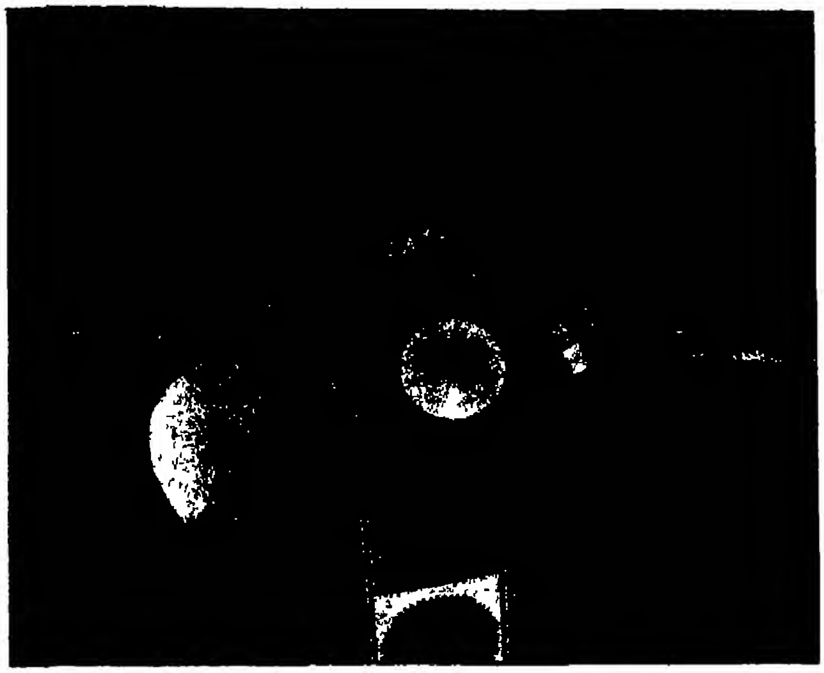
Such a device also has many new uses which the necessity of a heated filament prevents in the other

ALTERNATING AND RECTIFIED CURRENT CURVES

FIGURE 1 *The upper curve shows the variations of values for a non rectified alternating current. The middle one shows half wave and the lower one full wave rectification*

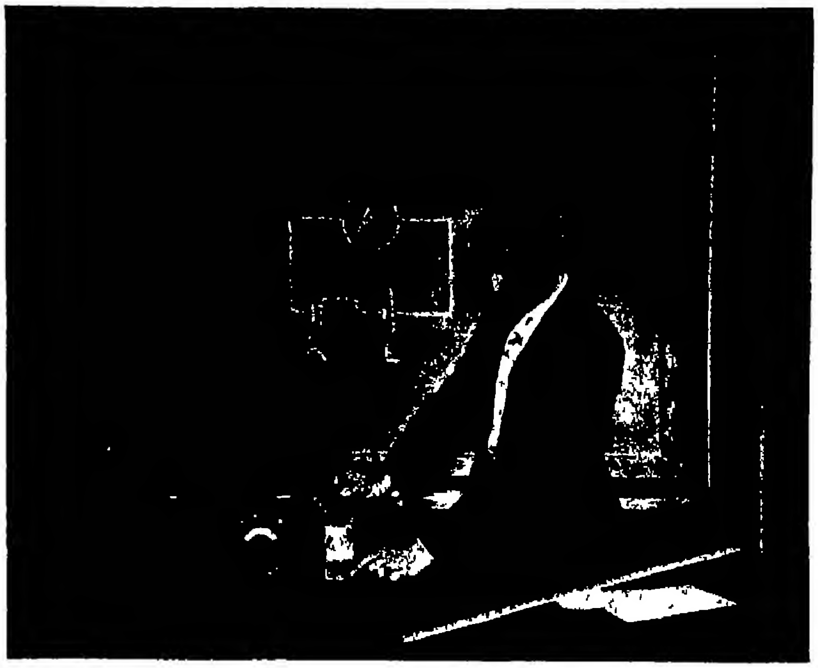
CONNECTIONS OF A BRIDGE RECTIFIER CIRCUIT

FIGURE 2 *To obtain full wave rectification with rectifiers of the type described four of them may be arranged and connected in a simple and efficient circuit as here shown*



ILLUSTRATING THE SIZE OF THE RECTIFIER

FIGURE 3 *Beside the watch is shown a home-made oxide rectifier Its convenient size and low internal resistance are important features of this efficient instrument*



TESTING THE RECTIFIER'S ACTION

FIGURE 4 *For testing the rectifier, the simple arrangement shown above will suffice A resistance may be necessary if the ammeter is taxed beyond its normal range*

types of high current rectifiers One of these is to convert a direct current instrument into one for measuring alternating current values To accomplish this it is only necessary to connect one of these new rectifiers in series with the instrument, for its low resistance is small compared to any circuit in which it might be inserted Other uses, perhaps not so obvious, will probably occur to experimenters

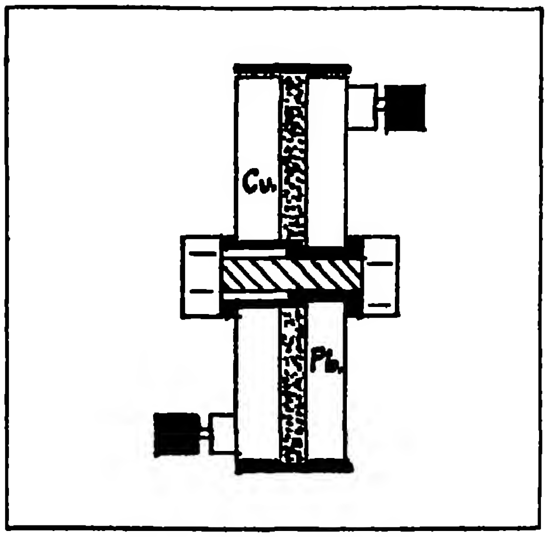
The purpose of this article is not to describe rectifiers with any great detail but rather to interest some of our readers in amateur research I have described this rectifier as it was reported, as consisting of a copper washer oxidized on one side and a similar disk of lead fastened tightly to it by an insulated bolt In the case of a similar rectifier seen elsewhere, however, the lead was replaced by a different metal and the oxide by another oxide. The latter was used in powdered form between the metals. This is shown in Figure 5

Many Combinations Possible

If anyone knew exactly what takes place in a rectifier of this sort he could go at once to the materials which would be best suited to the purpose, but there is anything but agreement among those who attempt to explain this phenomenon Here, then, is a chance for the amateur The man who can bolt together the greatest number of materials, work with them under the widest range of pressures et cetera, will probably get the best results

There are of course, some things which might guide the experimenter, one would not think of putting sawdust between iron on one side and glass on the other What then, would be the sensible things to try? The success of the rectifier described above would suggest two metals, with an oxide of one of them between It would be desirable however, to try other oxides as well Since there seems to be some inherent difference between the metals in contact with the oxide, it would seem desirable to use metals as widely different, electrically, as possible. This would lead to the selection of metals far apart in the electromotive series. This series is a list of the metals so arranged that if any two are placed in a dilute acid and connected by a copper or other conducting wire outside of the liquid, a current will flow from the metal higher up in the table to the one lower down. Thus, if a copper strip and a zinc strip are placed in a dilute solution of sulphuric acid and connected with a conducting wire outside of the solution, a current will flow from the copper to the zinc The copper is accordingly placed higher than zinc in the electromotive series Such a series can be found in any elementary text on chemistry It is noticeable however that the lead and copper used in the rectifier described are close together in this series, so that this may be the wrong key

Since it is a rectifier that is desired, it might seem reasonable to use between the washers some crystal substance which has properties of rectification itself, or which has some other unusual electrical properties There are many such For example galena, which has been mentioned already, will rectify If cut thin or powdered and put under pressure between plates its behavior might be greatly modified Argentite, molybdenite and many other crystals are affected by light in such a manner that they will produce a small current under proper conditions This is noticeable in nearly all silver sulphide crystals, so that here is another clew on which to work Crystals of rochelle salts are remarkable for what is known as a "Piezo-electric" effect When pressure is applied to such a crystal its opposite faces become charged electrically These crystals are difficult to obtain as they do not occur naturally in sizes large enough to work with and so must be grown artificially Crystals of selenium show a marked change in resistance with a change in intensity of illumination



RECTIFIER CONSTRUCTION

FIGURE 5 *In this sectional view, the black portions represent insulating material, and the dotted part is the oxide*

None of these suggestions may be on the right track, yet the effects in each case have a certain earmark of similarity and suggest a possibility of success which an experimenter could not afford to neglect The number of combinations which these suggestions would provide is very large and the likelihood of success is correspondingly high.

Testing Rectification

The question which remains to be answered has to do with the manner in which the experimenter is to determine the success of any particular rectifier which he may build The ideal way would be, of course, to use an oscillograph This is out of the question except in a well equipped laboratory, but for the purposes of development other methods will answer nearly as well Since the voltage required is small, a single dry cell and an ammeter are all that are required, and as the ammeter is used only for purposes of comparison it does not need to be at all accurate An ammeter such as is used in an automobile and which can be obtained very cheaply is perfectly satisfactory To test the rectifier, place it in series with a battery and an ammeter (Figure 4), take the reading, then reverse the terminals on the rectifier and read again The larger reading is usually called the "normal current" and the smaller is called the "reverse current" The smaller the reverse current in proportion to the normal current, the better is the rectifier Such readings made with direct current may not be a fair test for a rectifier designed to be used on alternating current, yet it will give information on which to base a judgment of different rectifiers of the same type

Besides the interest in the rectifiers themselves, it should be noticed that such a device as this, filling as it does an entirely new set of conditions, usually finds other special applications which were not previously known

Taking this invention, then, as it is, without intention of improvement or change perhaps the individual with some special interest may see a method of adapting it to his own purposes Before attempting to market any such device, one should be careful to comply with any patent restrictions which may exist.

Are We Over the Pole?

How Byrd and Bennet Were Able to Answer This Question by the Aid of New Navigation Instruments

By Nell Ray Clarke

THERE is no big nail in the top of the world to tell where the meridians meet. The navigator of the air uses the same principles of spherical trigonometry in finding the pole that the navigator of the ocean uses in finding his port except that the special conditions at the pole make his computations so simple that they can be made in advance.

The special conditions in the polar region require special navigation instruments and there are three which are absolutely essential to finding the pole when traveling in aircraft. The sun compass and drift indicator used together give the direction to go and the bubble sextant tells the distance traveled and indicates when the pole has been reached. The magnetic compass is carried along, but in arctic aviation it cannot be depended upon.

As at the north pole our conception of north, south, east and west becomes useless in describing direction, all directions being south, so at the north magnetic pole the directions indicated by the magnetic compass are useless. The force that in other parts of the world directs the needle there only tends to point the needle straight down toward the ground. If the compass needle could be restricted to move only in a horizontal plane, this vertical magnetic force could have no effect to move it. But let its axis of rotation be inclined from the vertical position then this vertical magnetic force immediately becomes effective in turning the compass needle. The direction and amount that it turns is dependent on the direction and amount that its axis happens to be inclined.

As in an aircraft it is manifestly impossible to keep any instrument in a horizontal position, the magnetic compass is kept in a continual state of motion that makes it useless as a direction finding device. This is not only true at the magnetic pole but over a very large area surrounding it.

It must be understood too that in regions where the magnetic lines of force have a very steep angle of inclination as they have near the magnetic pole, their horizontal components will be correspondingly weak. As it is this horizontal component only that has a desirable effect on the compass needle, the needle's direction is frequently dominated by the magnetism of the airplane and the vertical magnetic force just mentioned.

Even if all of these difficulties could be overcome there would still be another. In what direction would the needle point in regions never before visited? How can anybody know? Nobody does know with a satisfactory degree of accuracy.

Compass Points a Crooked Path

If the poet who said "true as the needle to the pole" had known a little more about terrestrial magnetism we would never have had that charming bit of fancy. The magnetic north pole is located on the Boothia Peninsula north of Hudson Bay and some 1300 miles from the north pole. Many who know that the compass does not point toward the north pole believe that it points toward the north magnetic pole but it does not do even that except once in a while. If one should start from anywhere in the world and go north as indicated by the compass he would eventually arrive at the north magnetic pole but he would follow a decidedly crooked path to his destination. Only a little of the way would he be going directly toward the north pole. The direction that the compass points in any locality cannot be predicted. It can only be observed. That is why we have magnetic surveys and why navigators' charts are covered with lines showing the direction the compass points at different places on the seas.

If we have to abandon the familiar cardinal points in describing direction at the north pole and the magnetic compass too, as a direction indicating instrument, what can we substitute in their place? The sun compass invented by Albert H. Bumstead, Chief Cartographer of the National Geographic Society and presented to Commander Byrd by that Society fulfills both these needs in a very satisfactory way, though only when the sun shines.

A glance at a polar chart with its meridians radiating in every direction and a thought of how at the north pole the sun circles the sky regularly once every day of summer suggest the sun compass so forcibly that the only explanation of its not having been made before is that nobody has wanted it.

Lay a polar chart on the table before you with the meridian that passes through your home town pointing south. Get out your watch and lay it, face up, directly over the north pole of the chart, with the XII mark over your own meridian. At noon the hour hand and the XII point of your watch and your meridian on the map will be all together and pointing south toward the sun. Transport yourself in imagination to the pole and think what the sun is going to do as the day advances. By 6 P.M. it will have made one quarter of the circuit of the sky and will be opposite the III o'clock mark on your watch. If your watch could be regulated to go at just half speed, the hour hand would exactly follow the sun around the dial and so long as the hour hand pointed to the sun the noon mark on your watch would point in the direction of your meridian. That would be a perfectly definite direction for regions near the pole, although whether or not it would be south would depend on whether or not one was on the meridian for which the watch was set.

The Bumstead sun compass makes use of this simple relation between sun and time and direction. It consists of a clock regulated to move a single hand once around in twenty four hours. The clock face has hour divisions and ten minute divisions. The clock is mounted on horizontal trunnions above a compass dial. The compass dial is marked in the usual way with the cardinal points and with degrees.

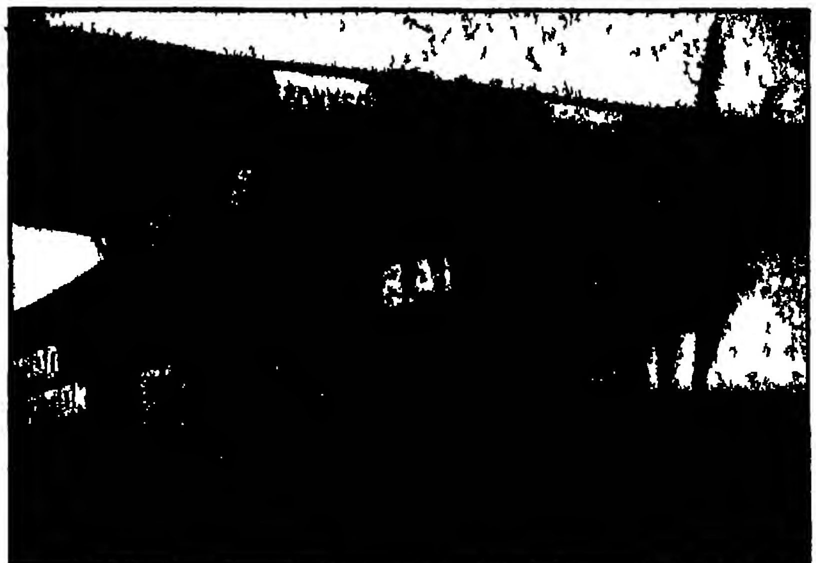
The trunnions permit the clock to be inclined at any angle with reference to the compass dial, but as the trunnions are parallel to the 6 A.M. and 6 P.M. divisions on the clock and to the east and west divisions on the compass dial, the noon and midnight markings of the clock are always in the vertical plane passing through the north and south marks of the compass dial.

This arrangement of mounting the clock permits of its being made parallel to the horizontal position it would have if laid flat at the pole. This is necessary as in no other position would the hand exactly follow the sun. To give the clock this parallelism it must be tipped from the horizontal position through the same number of degrees as there are degrees of latitude between the location where the

Photograph courtesy of U. S. Bureau of Standards

THE BYRD BUBBLE SEXTANT

This instrument provides an artificial horizon making its use in an airplane possible



Photograph by L. R. [illegible]

BYRD'S POLAR AIRPLANE

The three air-cooled engines as well as the operating cockpit are plainly visible

NAVIGATOR AND INVENTOR

Byrd, left, and Bumstead, inventor of the sun compass, checking one of the instruments

Photograph courtesy of U. S. Naval Air Station

A GREENLAND ICE FIELD

This photograph gives some idea of the terrain over which Byrd had to fly to the pole

sun compass is being used and the pole. A vertical arc is provided for making this setting, and it is merely necessary to incline the clock so that the latitude is read on this arc.

The hand of the clock is provided with a vertical shadow pin or gnomon which, in the sun's rays, casts a shadow along the hand, enabling the pointing of the hand toward the sun to be made accurately.

As the changing declination of the sun only changes the position of the end of the shadow along the clock hand, but does not move it from side to side, it is not necessary to take account of the sun's declination. This is a very important simplification of the methods for checking the compass known to every navigator.

Measuring the Airplane's Drift

The compass dial can be turned on its base and any desired heading set opposite a lubber line just as in a mariner's compass. The difference in use is that in the mariner's compass the lubber line is kept opposite the proper division of the dial by movement of the steering mechanism, while with the sun compass the sun's shadow is kept on the clock hand by movement of the steering mechanism.

The sun compass was the instrument used by Commander Byrd to indicate the direction of the meridian along which he wished to fly. He knew that if he could accurately follow that meridian he would pass over the north pole. But heading his plane north is no assurance that it is going to travel north. There are winds in the arctic as elsewhere and a plane's motion over the ground is the resultant of the motion of the air and the motion of the plane through the air. In a trap door in the bottom of the plane is a drift indicator. It consists of a window on which is a single line. This line can be turned horizontally into such a position that objects on the ground appear to move along it without crossing it. When it is so set it points in the direction the plane is moving with reference to the ground. The drift indicator is provided with an arc that shows the number of degrees between the heading of the plane and the direction of its motion. This same number of degrees has to be set off on the dial of the sun compass in order to keep the plane actually moving north.

On the skill of the navigator in the use of these two instruments and of the pilot in handling the plane depends the success of flying over the pole.

We have one more question. How does he know when he gets there?

The horizon at the pole is a plane parallel to the plane of the earth's equator. The sun's rays make almost exactly the same angle with one of these planes as with the other. This angle is called the "sun's declination." It is a continually changing angle, but its amount at any time is tabulated in the nautical almanac. The sun's rays are bent somewhat in passing through the earth's atmosphere, but the amount of this refraction is well known.

So a table can be prepared in advance giving the angular height above the polar horizon of the sun at any given time. The sun will be at the same height at that time all along a line (called a "Sumner line") at right angles to the sun's rays, but nowhere else. The polar navigator must time his flight to arrive at the pole at a time when the Sumner line cuts the meridian on which he has flown at a

THE BUMSTEAD SUN COMPASS

All of the important parts and graduated circles are shown

blunt angle, as it is the intersection of the Sumner line and the meridian that locates the pole. The best time for him to arrive at the pole would be when the sun was directly ahead or directly behind him. If the sun were at right angles to his line of flight he could not know when he arrived at the pole because his change of position would not make any change in the angle of elevation of the sun.

Commander Byrd arrived at the pole at 9 04 AM, Greenwich time, when the sun was about 33 degrees from his line of flight which, while not the best position, was very good.

Now the measuring of the sun's angle of elevation calls for a third instrument. Every navigator uses the sextant for this very purpose and is wholly dependent on it for knowing his latitude and longitude at sea. In the sextant, the line of vision is split by mirrors so that the sun can be made to appear to just touch the sea horizon. Hence the expression "bringing down the sun." When the sun is "brought down" by the sextant, an angle is read off from the limb of the sextant which with two or three known corrections is the sun's altitude.

The navigator of the air cannot use the ordinary mariner's sextant because his horizon is too distant and too indistinct and too much displaced on account of his height above the surface.

Reasonable Errors not Objectionable

Commander Byrd devised the bubble sextant in which a spirit level replaces the sea horizon. In it too, the line of vision is split so that in "bringing down the sun," the sun appears to be just centered about the bubble of the level. When Commander Byrd knew by the time he had been flying that he should be approaching the pole, he measured the sun's altitude with the bubble sextant. The readings became smaller and smaller as he went along and, when they reached the value that he had tabulated for the pole for the particular time, he knew he was there. Exact readings of altitude from a moving airplane cannot be made and it would be unreasonable to ask an aviator going at a speed of a mile and a half a minute to take an observation at the exact instant at which he passed over the pole or to say at just what moment he arrived there. If he has covered the ground and knows within ten minutes his time or within fifteen miles his position he has done all that reasonably can be asked. If he could land and make more careful observations from the surface, he would know within smaller limits, but there still would be a range of uncertainty. All measurements are subject to errors, even when made with the greatest skill and under the most favorable conditions, but when the errors are reasonably small and do not detract from the value of the result, we do not object to them.

So, while a possible 15-mile error could not be tolerated in a ship's position entering a harbor in a fog, it would be quite satisfactory for all intents and purposes for an aviator's location of the north pole.

The fact that Commander Byrd was able to turn about and retrace his steps, so to speak without a single landmark, and, after being in the air about 15 hours and flying 1,500 miles, to arrive at Kings Bay is in itself a spectacular example of accurate navigation and the strongest possible evidence that he knew pretty well where he was all the while.

An Attractive Live Ornament May Be Made from a Plant, an Old Electric Light Bulb, a Thistle Tube and a Paper Weight Assembled as Above

Plants Grow in Air-tight Containers

The Balanced Processes of Green Plants Enable Them to Live Almost Indefinitely in an Hermetically Sealed System

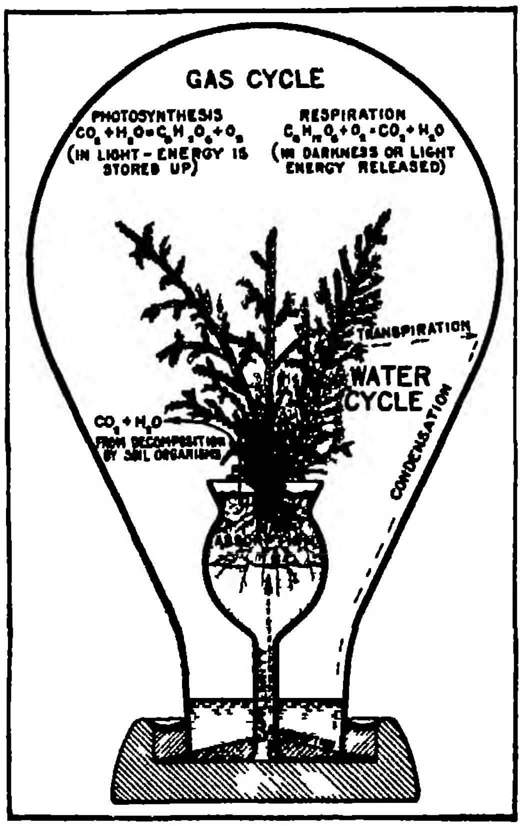
By Raymond H. Wallace
Fellow in Botany, Columbia University

ALL forms of life are characterized by their ability to adapt themselves to a greater or lesser extent to their environment in a manner most advantageous to themselves. It would seem almost impossible, however, for a living organism to be so constituted that its processes would enable it to live and grow in an hermetically sealed system that is isolated from all external factors except light and heat. Some green plants have this ability, however, and can live for long periods of time in such a chamber.

All living organisms take in food materials and excrete waste products. Hence, in order that an organism may survive for any length of time in a closed system its vital processes must be cyclic so that no essential substance becomes unavailable or exhausted. It is plainly evident that an animal could live such a confined existence for only a very brief period since it must be supplied with a source of energy such as food and the oxygen supply must be continually replenished, otherwise it would be suffocated by the products of its own respiration.

How Plants "Breathe"

It has long been known that green plants carry on two processes, which fact makes it theoretically possible for them to live for long periods of time hermetically sealed. One process is respiration by which plants break down stored food in the same manner as do animals, although usually at a much slower rate. The other process is photosynthesis or the assimilation of carbon dioxide and water to form food. Since photosynthesis is the more vigorous reaction, being in some cases more than forty times as rapid in terms of gas exchange as is the respiration in the same individual, plants are able to accumulate a surplus of organic products such as carbohydrates, fats, et cetera. It is this excess in the plant world of food manufacture over food destruction that makes possible animal life in its various forms. During photosynthesis, oxygen is continually given off, and it is this established fact that has probably given rise to the erroneous conception commonly held by laymen that plants "breathe" in only carbon dioxide and give off oxygen.



THE UNIT CYCLE
This is maintained only by certain kinds of plants

A comparison of the chemical reactions occurring in the processes of respiration and photosynthesis will show how it is possible for some plants to adjust their gas relation so that they can live in a small closed chamber. In simple terms respiration may be expressed as follows: Carbohydrate plus oxygen forms carbon dioxide and water, energy being released. Reverse the formula as follows: Carbon dioxide plus water in the presence of light forms carbohydrate and oxygen, energy being stored in the form of food, and we have the simplified formula for photosynthesis. If the volume of carbon dioxide evolved in respiration should equal the volume of oxygen evolved in photosynthesis, the photosynthesis-respiration ratio would be unity and the gas pressure would remain constant.

Effect of Darkness and Light

The process of respiration is a very general reaction occurring in all living organisms at all times, but the process of photosynthesis is more restricted, occurring only in green plants in the presence of carbon dioxide, water, and light. A plant respires at all times but in sunlight it quickly converts the carbon dioxide present into carbohydrate by the energy of light and may thus maintain the food and oxygen cycle, even when in a closed container. In darkness the partial pressure of oxygen is gradually reduced by the respiration of the plant and carbon dioxide replaces it, but in the presence of light the reverse process of photosynthesis occurs and the partial pressure of carbon dioxide is quickly reduced to practically zero with the result that the partial pressure of the oxygen is re-established to its former value.

Even though the theoretical possibilities of a green plant living in a closed system appear so favorable, it seems never to have been thoroughly

established experimentally. However, it is quite commonly known in botanical circles that algae, such as pond scums, or algae and a small fish, can live in bottles of water which are almost, if not entirely, hermetically sealed. Also one case is reported in which a volunteer fern has grown for years in a sealed soil sample, but apparently no attempt was made to extend the observations further

It sometimes happens in experimental work that a failure to follow the standard technique of an experiment may lead to interesting results of a nature entirely different from those for which the experiment was designed. The method here described of growing plants in sealed containers is of that nature, being the outgrowth of an observation made in connection with some experiments as to the effect of illuminating gas on plants

Chance Led to Discovery

In these experiments various plants were placed in inverted bell-jars sealed by means of ground glass plates and vaseline Circumstances prevented the dismantling of the apparatus at the end of the usual period of ten days or two weeks and the plants were left sealed. At the end of a month all were green and growing, apparently none the worse for their enforced seclusion It then seemed interesting to determine how long they would continue to live and grow, so the plants were left unmolested. At the end of seven months they were still vigorous and healthy How much longer they would have continued was not established, because the jars were accidently broken open. This incident suggested that if big plants would grow in big containers, little ones should grow in little containers.

The apparatus here illustrated was thereupon devised It consists of three principal parts· a bulb a base, and a plant container which in this case is a thistle tube The plant is potted in soil, and the apparatus is then hermetically sealed at the base A quantity of water suitable for the type of plant being tested is included in the apparatus before sealing The "set up" now requires no further attention except to allow it to stand in adequate light for a part of each day

An important consideration aside from the gas cycle of respiration and photosynthesis is the water cycle of the plant This also must be automatic, otherwise the plant would die from lack of moisture in the soil Plants do not seem to have the ability to take water from the air even though the atmosphere be saturated In bulbs such as described, water that has evaporated from the soil and plant condenses on the walls of the bulb and runs down to the base where it is absorbed by the porous plaster of Paris It then rises by capillarity into the soil around the roots of the plant and is there absorbed Thus it again becomes available for evaporation

The balance in the gas cycle and water cycle explains how a green plant can live in a closed system But how can it increase in size? The answer is suggested by a simple biological fact Humus, such as leaf mould, is at all times being decomposed by microscopic soil organisms to form carbon dioxide and water In this manner, by potting a plant in a rich humus containing soil, the plant is constantly receiving a slightly greater amount of carbon dioxide than just that derived from its own respiration This additional amount can be utilized in growth.

A TOBACCO PLANT
This will thrive vigorously when left in sunlight

Fatal to Some Species

Growth is evidenced in some plants simply by the development of additional foliage, but in others there is an interesting cyclic phenomenon in the death of old leaves and the development of new ones to replace them This is especially true of ferns This cyclic replacement of leaves seems to be a survival of the fittest, the younger tissues being more vigorous and full of vitality and therefore able to supersede the older, less active members

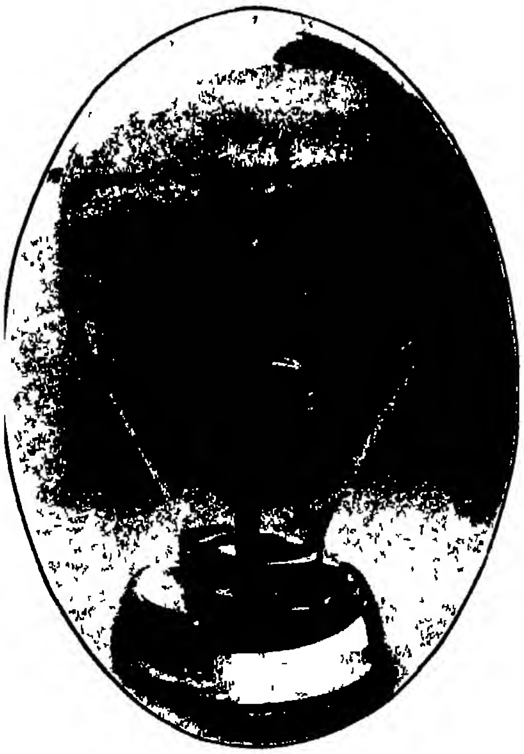
Many species of plants can not survive for any great length of time when hermetically sealed in this way Among thirty species so far tested, less than fifty percent seem able to adapt and maintain themselves in such an environment Failure to survive may be due to the plants maintaining a photosynthesis-respiration ratio which is other than unity In this case death may result from auto-asphyxiation or starvation, depending upon whether the oxygen or the carbon dioxide is the gas exhausted. The saturated atmosphere inside the bulb may cause the death of some species, since observations have shown that some plants die or at least become pathological when grown in a saturated atmosphere Environmental conditions inside the bulbs are particularly favorable for many forms of bacteria and fungi, and if pathogenic forms are present when the apparatus is sealed, they very often bring about the death of the enclosed plant.

Plants are often classified as sun or shade plants, depending upon the light conditions under which they grow best and it has been found that the two types react differently in these chambers. A sun plant, such as tobacco can live for only a few days unless it is given strong diffused light, while a fern or club moss will die under the same treatment, but thrive when kept in weak diffused light Sun plants as a class are rather unsatisfactory for these chambers, since the heat that accompanies the greater light intensity is imprisoned by the bulb and tends to injure the plant

Plants More Adaptable than Animals

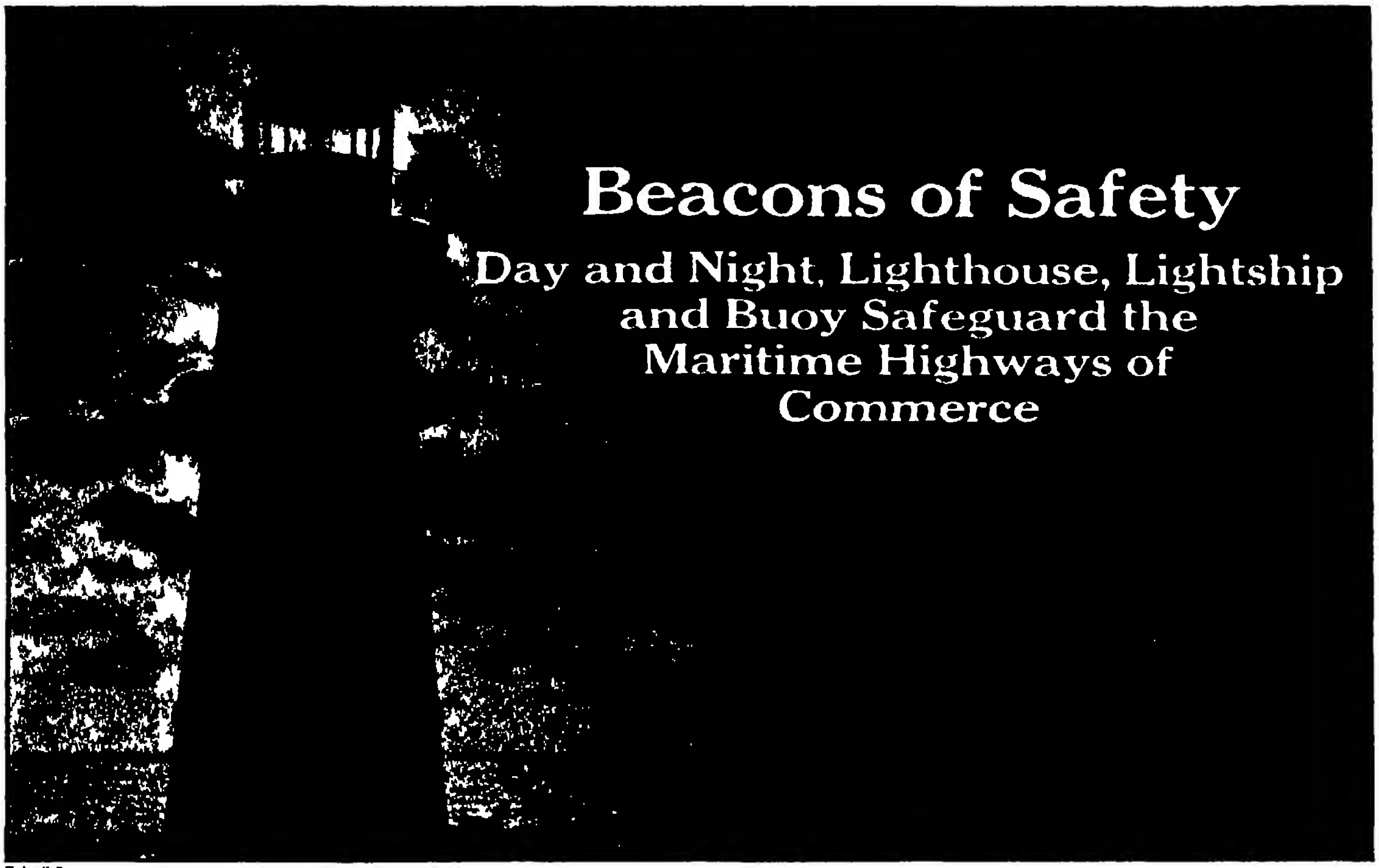
The ability of a plant to survive in a closed system seems to bear no relation to its evolutionary position in the plant kingdom, species from club mosses to flowering plants have been tested with successful results Plants which normally require a rather high relative humidity for their best growth seem to do better than those growing best in a dry atmosphere Many plants when taken from greenhouse conditions and sealed, will quickly lose all their leaves and then grow a new set which is apparently better adjusted to the moisture conditions in the new environment So far no plant has produced viable seed, thus completing its normal life cycle There is, however, no theoretic impossibility of demonstrating such a complete life cycle in a properly adjusted container of sufficient size This suggests an interesting series of experiments

These green plants living and growing in hermetically sealed containers give an interesting demonstration of the cyclic processes occurring in some organisms Also the enclosed plants in their form and appearances show excellent examples of the adaption of organisms to their environment The theory that plant life preceded animal life in its appearance upon the earth is held by many scientists and this ability of green plants to live the confined existence told of here demonstrates the definite possibility that this could have been the case.



THE CLUB MOSS
Such plants must be kept from sunlight as in nature

SENSITIVE PLANT
Some plants will fold up when the glass is jarred



Beacons of Safety

Day and Night, Lighthouse, Lightship and Buoy Safeguard the Maritime Highways of Commerce

Ewing Galloway

APART from its inestimable value to maritime commerce the lighthouse service makes a strong sentimental and even dramatic appeal to those of us who have occasion to go down to the sea in ships. The brilliant far flung shaft of light from some towering lighthouse and the twinkling light from some channel buoy are alike the trusted friend of the voyager—none more eagerly watched for and none more warmly welcomed.

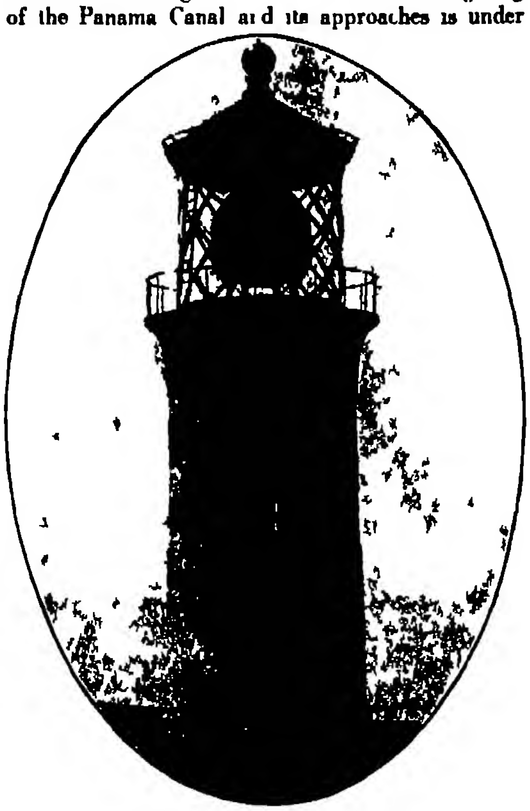
At the time of the organization of the United States Government there were ten lighthouses owned and operated by the colonies. These had been built between 1716 and 1789 when Portsmouth Harbor Light was erected. Five other lighthouses were under construction by the colonies and Virginia had gathered materials for a lighthouse at Cape Henry. It is of interest to note that of these 16 light stations all are in operation today.

A 40,580 Mile Coast to Guard

The institution of a fog signal system dates from 1719 when a large gun was installed at the Boston Light, "to answer ships in a fog," and this gun which bears the date 1700 can still be seen at Boston Light Station. Boston Light was burned by the Americans more than once during the war and repaired by the British who however on evacuation blew up the light. For seven years thereafter there was no light shown but in 1783 the legislature rebuilt the light on the original lines.

The United States Lighthouse Service "is charged with the establishment and maintenance of aids to navigation." Its executive office is in Washington, D. C., under the Commissioner of Lighthouses, George R. Putnam. The service is divided into 19 lighthouse districts and the force is composed of civilians except in the three river districts which are in charge of officers of the United States Corps of Engineers. One or more lighthouse depots in each district serve for the storage and distribution of supplies and apparatus. Also on Staten Island, New York Harbor, is a general lighthouse depot where many supplies for the whole service are stored and sent out for distribution, and much technical work in the way of testing apparatus and supplies is carried on. Each district is provided with a lighthouse tender.

The jurisdiction of the lighthouse service covers the Atlantic, Gulf, Great Lakes and Pacific Coast, the principal interior rivers, Alaska, Porto Rico and Hawaii and all other territory under the jurisdiction of the United States. The Philippine Islands provide their own lighthouse service, and the lighting of the Panama Canal and its approaches is under the care and supervision of the federal government.



AN HAWAIIAN LIGHTHOUSE

Situated on Kauai Island it is 216 feet above sea level

The total length of coastline thus served totals 40,580 statute miles, and to safeguard this great stretch of our shores calls for a total of 16,373 aids to navigation, of which 5,799 are lighted and 10,574 are unlighted. Under the heading of "lighted" are the main lights, minor lights, light vessels, gas buoys and float lights. Under the head of "unlighted aids" are fog signals, radio fog signals, submarine signals, whistling buoys, bell buoys, other miscellaneous buoys and day beacons.

The term "minor light" includes post lights and small lights generally not attended by resident keepers but looked after by persons living in the vicinity. Light vessels are used as a rule to mark off-shore dangers or approaches to harbors where the building of a lighthouse is not practicable or economical. Gas buoys mark important channels or shoals and act as general guides for navigation. Float lights are small lights carried on a float or raft and they are used at the less important places.

Buoys and Spars Most Numerous

Fog signals include various types of air and submarine sound producing apparatus and radio signals for thick weather. Radio fog signals are low powered radio stations sending automatic signals from lighthouse or lightship, which are received by radio compasses on the ship and enable navigators to obtain their bearings. Submarine signals are auxiliary fog signals, which are sent out from bells operated under water. They are usually placed on light vessels. Whistling and bell buoys are operated by the motion of the buoy in the sea.

The most extensively used of all aids to navigation are buoys and spars of various types. Day beacons include minor fixed structures which do not carry a light, the most common being a post or spindle bearing a target of distinctive shape and color.

It is of interest just here to record the total number of principal light stations, light vessels and fog signals throughout the world. These, however, do

not include the Great Lakes of North America nor rivers beyond the limit of sea-going navigation.

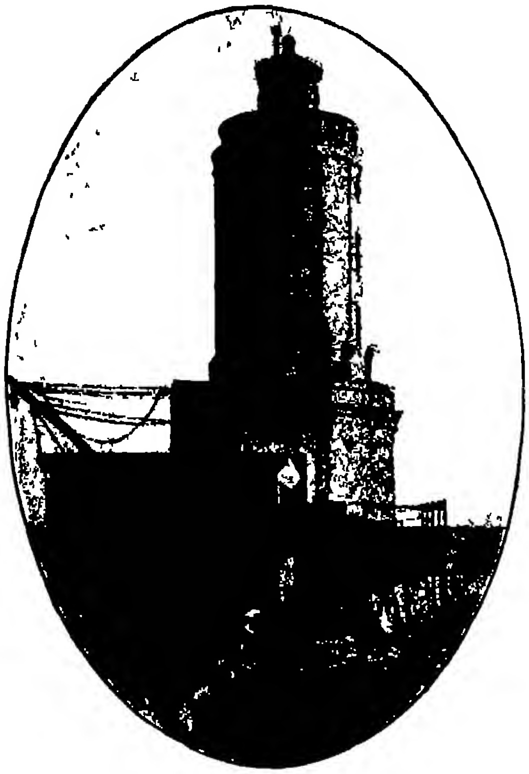
Continents	*Light Stations*	*Light Vessels*	*Fog Signals*
Europe ..	7,428	167	806
North America ..	3,085	47	696
Asia	1,532	38	122
Australia and Oceania	755	3	23
Africa	622	1	13
South America .	398	7	17
Total . ..	13,820	263	1,677

The lighthouse proper is an attended light where resident keepers are employed, and the types of these vary greatly. The common form for harbor or lake lights is a combined tower and dwelling of timber or brick construction. For the more important lights, the tower is separate from the dwelling and generally is of fireproof construction. The towers of this type are of masonry with stairways, lantern, et cetera, of cast iron. Those of a more recent type are built upon a structural framework of wrought iron or steel with an enclosed stairway in the center. The latest development is seen in the modern reinforced-concrete towers which are now standard.

Evolution of Our Modern Lighthouses

Complete equipment of a light station on land consists of the light tower, oil house, fog signal building, keeper's dwellings, workshop, water supply and drainage system, landing wharf, boathouses, barn and other structures. Where there is no convenient projecting peninsula or island or rock to carry a lighthouse, some difficult engineering work frequently has to be done. In some cases, a massive cofferdam is sunk through the overlying sand or mud until a firm foundation of rock or suitable bearing material is reached and upon this is built the concrete or masonry structure. Elsewhere, circular steel cylinders are sunk, dredged out and then filled with concrete. In other cases, as on the Great Lakes, cribs filled with stone are placed on the bottom and capped with concrete or other masonry. Many lighthouses are built on the ends of breakwaters or pierheads at the entrance to harbors—the existing structure being used as a support, and strengthened to provide a sure foundation and avoid vibration.

The height of the towers is determined by the nature of the shore and the importance of the light. On the Atlantic Coast where the shore is low, tall towers are required. On the more lofty shores of the Pacific, low towers on prominent headlands suffice. The tallest tower, at Cape Hatteras, is 193 feet high. Cape Charles 191 feet, Cape May 170 feet, Fire Island 167 feet, and Cape Henry 165 feet are some of the tallest of our lighthouses.



ON A CALIFORNIAN BREAKWATER
This harbor lighthouse has a beacon of 67,000 candle power

The earliest lighting apparatus consisted of an open coal, wood, or pitch fire burned on the top of the tower. The first Boston light used the customary oil burner of the period, the illuminant being fish or whale oil. By 1812, sperm oil, burned in a lamp on the Argand principal was in general use. By 1840 the bull's eye "magnifiers" had given place to reflectors, paraboloid in form and heavily silvered. Then came the Fresnel lens which is built up of glass prisms in panels—the advantage of which consisted in the greater brilliancy and the fact that a large proportion of the light is concentrated into powerful beams useful to the mariner. Kerosene came into use in 1877 and it ultimately became the principal illuminant—the present form consisting of a concentric wick using five wicks for the largest sizes. The latest and most important lights burn vaporized kerosene under an incandescent mantle. Acetylene and oil gas are used for lighted buoys, unattended lighted beacons, et cetera. One of these, located in Molokini Island, Hawaii, has burned continuously night and day since it was installed in 1911.

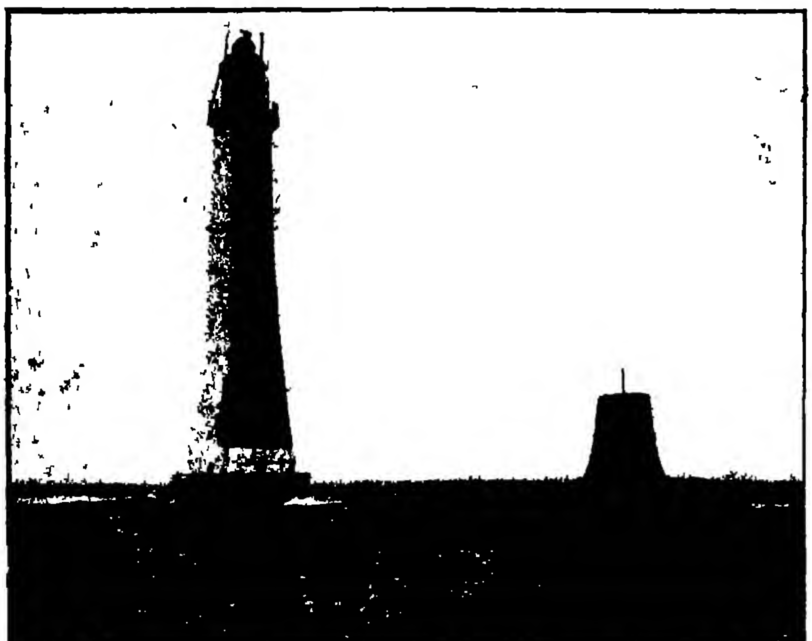
The lights on a properly marked coast should be so close that a vessel approaching land will always be in sight of at least one light, and this condition is met on our north Atlantic seaboard. To avoid confusion between lights, they are given distinct characteristics and the more important now carry flashing or occulting lights—the effect being produced by revolving the lens or by some form of moving shutter which shuts out the light at intervals, the motion being regulated by clockwork.

A Beam of 712,000 Candle Power

The range of the light is determined by its height above sea and its power. The highest light is at Cape Mendocino, 122 feet above high water, with a range of about 28 miles. The strength of illumination is measured in candle power—the most powerful light in this country being at Navesink, New Jersey, which throws a beam of 712,000 candle power.

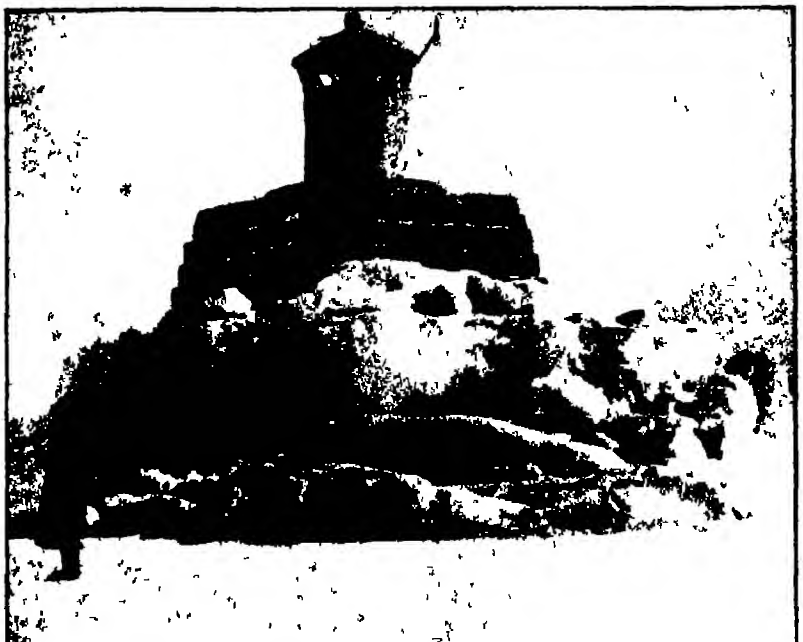
In case of fog, the work of the lighthouse is taken up by the fog siren, which may be described as a powerful whistle and horn operated intermittently by steam or compressed air.

The lighthouse service maintains light vessels at 49 stations. They are generally employed for marking dangers at sea, approaches to harbors and important points in the courses of vessels, in locations where a lighthouse could not be built. Their equipment consists of powerful lights at the mast head, sirens and submarine bells. Since they must stay out in all weathers, they are stoutly built with a high freeboard and heavy moorings. Careful provision is made for the comfort of the crew, which consists in a first class vessel of four or five officers and ten or eleven men. Although the work of the service is primarily concerned with the maintenance of aids to navigation the records of the service are replete with many heroic rescues of persons or vessels in distress—the annual report for 1921 recording 125 occasions in which salvage of life or property was rendered by employes of the lighthouse service.



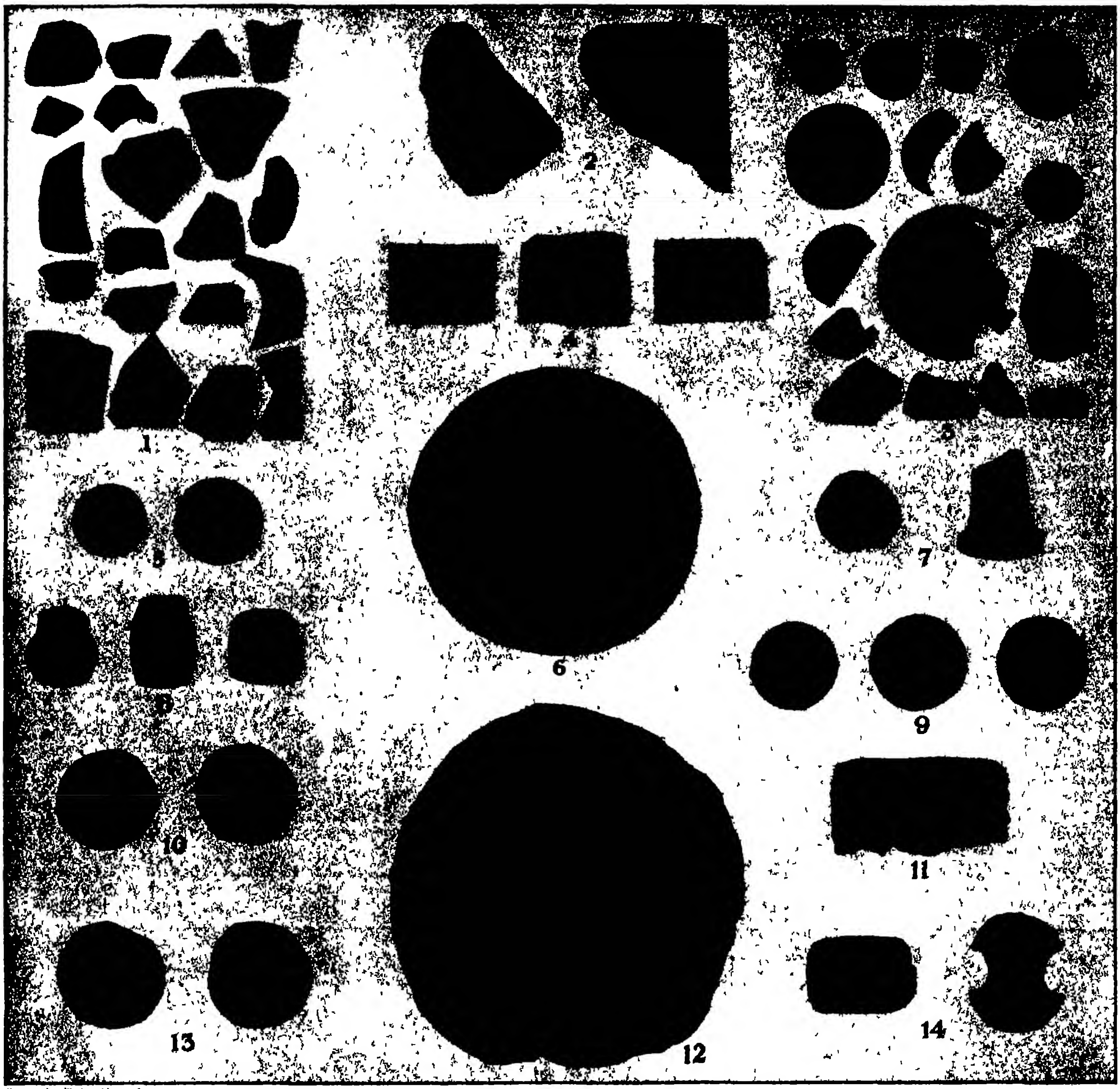
Photograph by P & A. Photos

THE OLD AND THE NEW
The newer Eddystone lighthouse at Plymouth is shown to the left of the old tower



Photograph by Williams Service

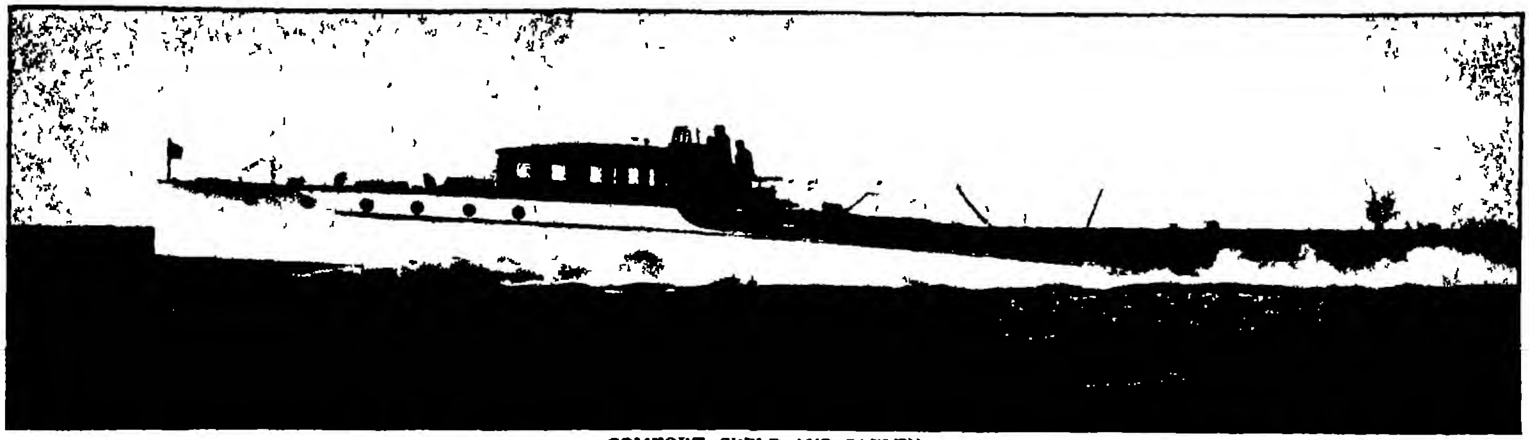
AN AUTOMATICALLY OPERATED WARNING
The photograph shows one of the beacons off the coast of Maine during the winter



Courtesy the Illustrated London News

Fingerprints as Identification Marks in Ancient Greece—a Brief for Early Trade-marks

It will probably be news to our readers to know that a knowledge of finger prints may be added to the list of Greek achievements. We present a most interesting series of pictures reproduced from "The Argive Heraeum" by Sir Charles Walston, Litt.D., Ph.D. (Houghton-Mifflin & Company). Sir Charles believes that the Greeks recognized the remarkable individualistic character of fingerprints and made some practical application of this discovery, such as the use of a fingerprint as a seal or trademark. He supports his theory with cogent arguments and the very interesting illustrations tend to demonstrate this, particularly, examples numbered 5, 6 and 7. The little seal or vase foot is the foundation of his theory which was tested by comparisons with fingerprints in the Galton Laboratory and in the files of Scotland Yard. He considers that regular stamps and dies were produced and then pressed into the softer material. The various examples may be briefly referred to as follows: 1. Incised free hand lines made regular by the potter's wheel. 2. Impressions on softer material by a stamp or die. 3. Painted linear ornament made regular by the potter's wheel. 4. The nearest actual type corresponding to the ancient Greek terra cotta, fingerprints from Scotland Yard. 5. At the left is the base of a small "tear bottle" with a print resembling a fingerprint; at the right, base of a seal or vase foot bearing a fingerprint pattern. 6. Enlargement of the base so as to bring out the pattern. 7. The base itself and at the left an impression from a tear bottle base. 8. Modern vases made to test whether the Greek patterns were due to the potter cutting the vase from the wheel by a string. 9. The bases of the wooden vases show no such fine lines as the Greek examples. 10, 11, 13, and 14, are given as examples of engraved stones, gems and ivories showing primitive work nearest in shape to the fingerprint terra-cotta fragment. 12. We are not deceived by the unintentional fingerprints of the potter as shown on an Egyptian wine-jar stopper. The archeologist has constantly to be on his guard against false conclusions drawn from purely circumstantial evidence.

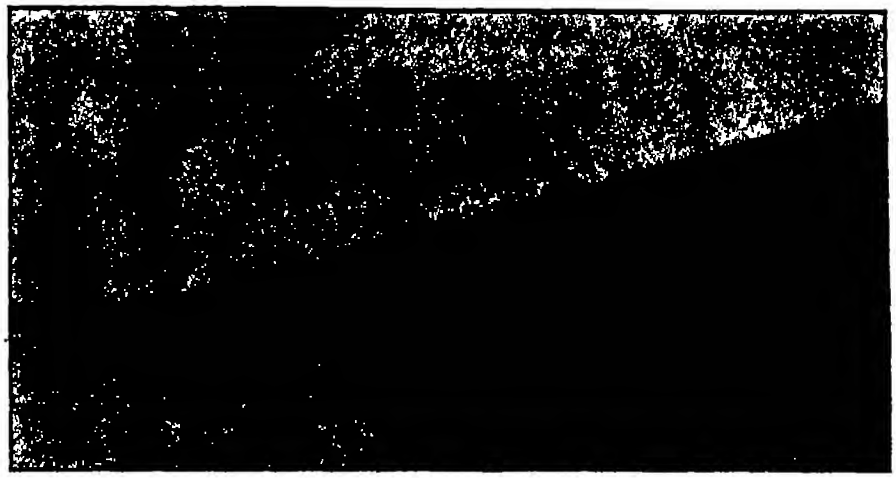


COMFORT, SPEED AND SAFETY

These were the requirements for this express cruiser which is 76 feet long with 13 feet 6 inches beam Perfect in her appointments and phenomenal in performance, the layout segregates all the operating functions from the quarters of the master, thereby assuring privacy while the mechanical design accomplishes a speed of 14 miles per hour

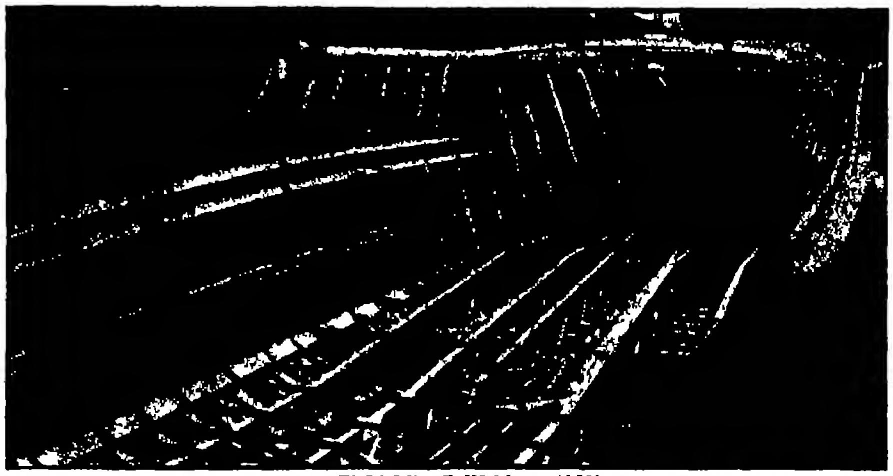
MAYBACK ZEPPELIN ENGINES

Reversible engines like the above, of 450 horsepower, form the power plant. Coordinate control makes possible operation as a unit, complete reverse being accomplished in six seconds



AN UNIQUE FEATURE

The water-lubricated cutless rubber bearings used throughout on the propeller shafts are unusual. These are grooved spirally opposite to the turning direction of the shaft, thereby forcing water through the bearings at all times Such flexible bearings act to eliminate vibration by holding the shafts in perfect alignment and also do away with the necessity of periodical oiling



A NEW TYPE OF HULL DESIGN

This has been created by embodying the methods used in Zeppelin airships Double planking and oak frames reinforced with steel, are stiffened by a separate framework constructed of special corrosion-proof duralumin which is not only strong but exceedingly light

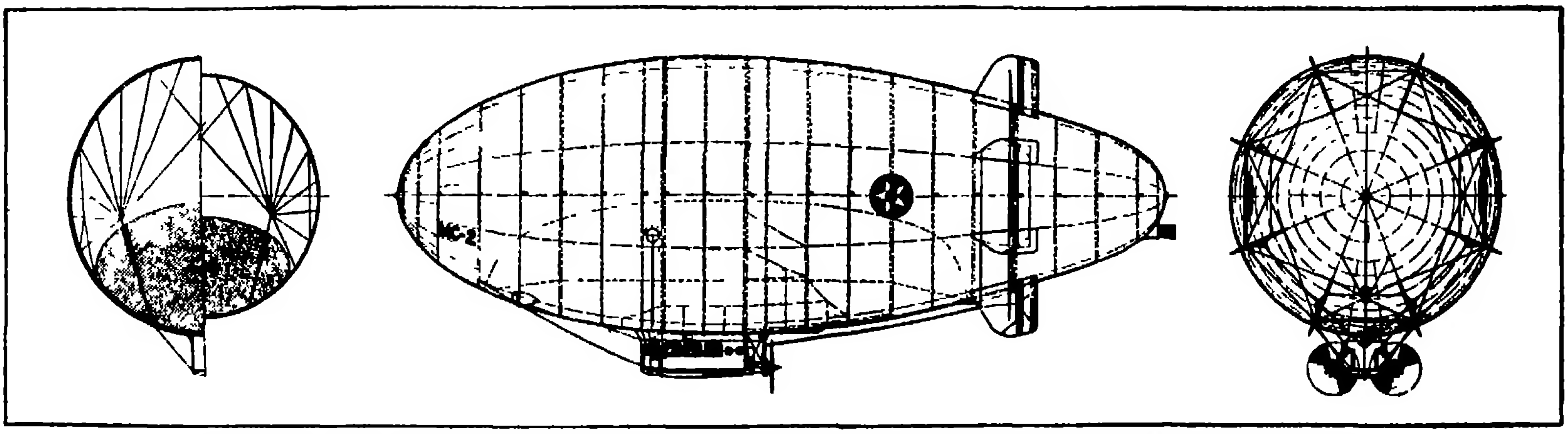
A Zeppelin Express Cruiser

Lessons learned in the air have now been applied to the water. A new type of express cruiser has been demonstrated which has a light hull reinforced by a separate duralumin framework, thereby assuring ample strength to carry powerful engines similar to those of the dirigible, *Los Angeles*

Three 12-cylinder V-type motors with roller bearings throughout, in place of the usual babbited bearings, develop 1,350 horsepower at 1,400 revolutions per minute, consuming .42 to .48 pounds of gasoline per horse-power hour Special carburetors render the engine fireproof

A central control at the bridge, operates the three motors in unison. One cam shaft controls all the valves This can be shifted so that the motor will drive ahead or astern without a clutch, complete reverse being accomplished in six seconds. Compressed air is used for starting

A new type of quiet running gasoline electric generating set is used, which furnishes power at 110 volts, so that all accessories may be of the usual household standard This generator can be immediately set into action by throwing an electric switch in any place in the boat



THE ALL-METAL AIRSHIP, *MC-2* HAS A GAS CAPACITY OF 200,000 CUBIC FEET AND A CRUISING RANGE OF 2,200 MILES AT 70 MILES PER HOUR

Metal versus Fabric

All-metal Naval Airship in Which Duralumin Plating Is Used as an Outside Covering

THE substitution of metal for wood and woven fabric in the construction of airplanes is one of the outstanding successes of the past few years of airplane design and construction. It was 16 years ago that the Scientific American offered a tentative design for an all-metal plane and pointed out the advantages of strength, reliability and high speed that would characterize a fully streamlined monoplane machine, if it were built throughout of one of the new metal alloys. To the Junkers airplane, produced some eight years later, is due the credit for the first successful demonstration of the practicability of an all-metal plane. Since that time, progress has been so rapid, that practically all of the up-to-date machines embody metal either in part or entirely in their construction. It was an all-metal plane, it will be remembered, that carried Commander Byrd on his memorable trip from Spitzbergen to the north pole and back.

The use of metal having proved such a success in airplane construction, it was inevitable that some progressive engineer would attempt its use in the construction of airships, and it is now some five years since a group of leading automobile manufacturers of Detroit authorized their chief engineer, Ralph H. Upson, to proceed with his designs for an all-metal ship. The confidence which led the Aircraft Development Corporation to enter upon the heavy expense of this investigation was based upon a consideration of five notable advantages which such a ship would possess over the present skeleton-frame, fabric covered dirigible. These are strength, resistance to complete fracture, lightness, fireproof quality and durability particularly as regards resistance to the effects of the weather.

Mr. Upson saw that to bring the present rigid airship up to the point of efficiency realized by the metal airplane, in its own field, would be a problem of engineering and production. An airship of this type must be fireproof, weatherproof, durable and firm in its structure, able to meet and carry through in any kind of weather that it may encounter, and lastly, economical in the use of gas and ballast.

Use of Metal Cuts Down Weight

Experience with the present dirigibles has shown that, after not so very many months of continuous service and exposure to the atmosphere and weather, the fabric covering deteriorates so rapidly that the ship is no longer safe to navigate, and when that point is reached, the old covering must be removed and an entirely new one put on.

The first design, which was for an express airship of 1,600,000 cubic feet, revealed a load-carrying capacity, speed and power efficiency superior to that of the larger fabric covered ship, *Shenandoah*. Moreover, in summing up the statement of weights, the encouraging disclosure was made that there would be an actual reduction in weight as compared with fabric-covered ships. This is due largely to the fact that the outside metal plating not only carries the tensile and shear stresses, but also, by so doing, reduces the size and weight of the internal framework. For we must bear in mind that, because it yields so rapidly to pulling or stretching loads, the outer fabric cannot take care of the shearing stresses, its only function is to resist the air pressures developed in flight and to give to the ship the necessary, unbroken streamline form.

In the *Shenandoah* the shearing stresses were carried by an elaborate system of diagonal wires between the various intersecting points of the metal framework. Were it not for these, the bending stresses on the hull would cause the framework to twist out of shape. Just here it is interesting to note that Rear Admiral Dyson, one of our ablest engineers, noted on his inspection of the wrecked ship that several of these diagonal wires in the framework, either broke or pulled out from their connections at the intersections of the main girders.

Both the mathematical and experimental investigation of the metal ship showed that the metal cover can take care of these stresses with a considerable factor of safety.

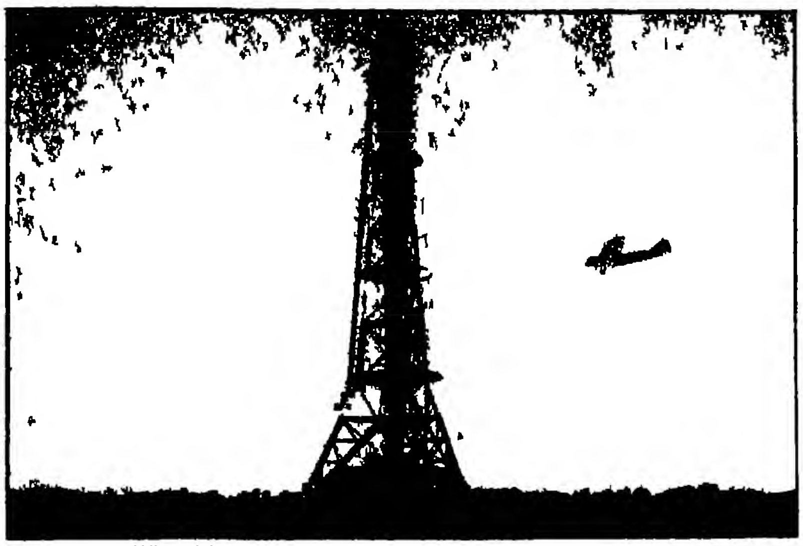
Compared with the fabric-covered ship, the metal clad has but one surface layer as against five layers (exclusive of frame) from outside to inside, namely: first, the outer covering fabric, second, the shear wiring, third, a network of wiring to take the gas pressure, fourth, the cord nettings, and fifth, the gas cell fabric lined with goldbeater skin. To these must be added the main framing of the ship. As compared with the above, the metal-clad ship consists of an exterior gas-tight, metal-covered shell, to the inside of which is riveted a system of longi-

ENGINES FOR THE *MC 2*

These three-cylinder engines show the type of the nine-cylinder ones to be used

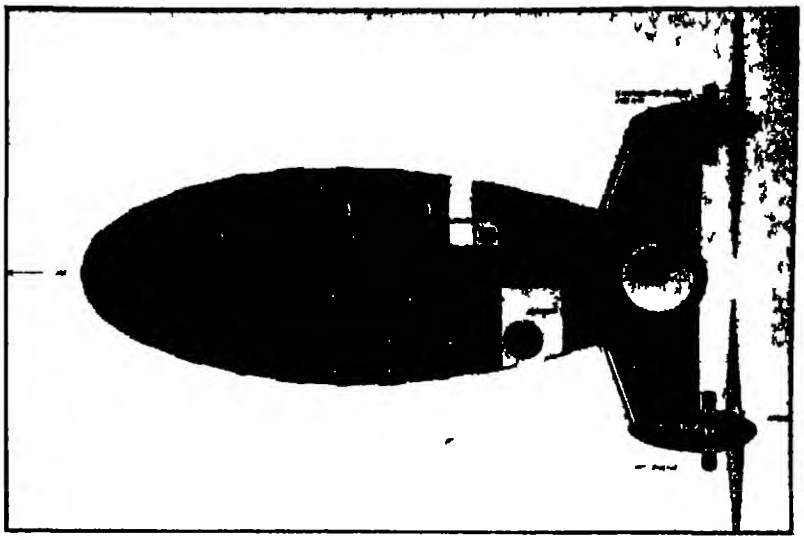
THE ALL-METAL CAR

The framing and the corrugated sides and floor are of special duralumin metal



NEW TYPE MOORING MAST AT FORD FLYING FIELD

The ship moors at the top of track at left and is hauled down the track to the ground



PLAN OF CAR OF THE MC 2 SHOWING ENGINES

Notice the pullman accommodations galley lavatory fuel tanks and control equipment

tudinal and transverse girders which, because the shear stresses are taken in considerable part by the metal cover, is relatively much lighter than the corresponding independent framing of the fabric covered ship

For several years past the Aircraft Development Corporation has carried on a series of investigations in the navy wind tunnel in the laboratories of the General Motors Company and at the Bureau of Standards, Washington, D C

It was decided to build at first, a small experimental ship of 200 000 cubic feet capacity which is about the size of the largest known non rigid blimp that has so far been constructed in this country At recent hearings before the Committee on Naval Affairs of the House of Representatives the leading officials of the company including Ralph H Upson Chief Engineer and Carl B Fritsche General Manager appeared before the commission and presented the mass of data which had been gathered As a result it was decided that the new ship should be built for the navy to be used in experimental service and for general training purposes and an appropriation of 300 000 dollars was recommended

As regards the matter of construction instead of building the girders of triangular cross section, with three longitudinals latticed together comparatively simple girders of modest proportions will be used for short spans, intercostals, and stiffeners These are formed out of a single sheet and finished in a punch press Various sample control members such as fins and rudders have been built and loaded with sand to the point of destruction In every case they have exceeded the designed factors of safety In fact samples of most of the other members and details have been made with the result that the actual building of the ship will be mainly a job of reproduction

Since the 200,000 cubic foot capacity ship which is to be built for the Navy contains no separate gas cells but consists essentially of one gas cell formed by the metal covering it will be realized that the matter of gas tightness is all important The seams of the metal both longitudinal and lateral are lap riveted with three rows of rivets to the seam To do this work a most ingenious little riveting machine has been developed by Edward Hill formerly of the naval aircraft factory at Philadelphia which is capable of putting in 7 500 rivets per hour Three small wire rods pass through the upper arm of the riveter and punch their way through the plates They are then sheared off and the rivet heads closed — all of these operations being automatic and continuous The all important question of gas tightness has been solved by these triple riveted seams It was already known that riveted steel gasometers are much tighter than any holders made of fabric and hence the same relative rivet spacing was adopted as is used in gasometers The rust that works into the seams of a steel gasometer assists greatly in making them tight, and this quality is supplied in the airship by using a specially prepared seam dope Here again surprising results were obtained Careful tests have shown that this rivet and dope construction averages, in the specimens tested less than one tenth the leakage usually specified for goldbeater skin fabric

Zeppelin Shape Not Efficient

Another advantage of the use of metal covering is that it eliminates the flapping and the moisture absorption which are common to fabric Critics of the use of metal covering have claimed that it would fail due to flapping and vibration effects Laboratory tests however have shown that, after combined flapping and torsional stresses, carried to the extent of many millions of movements, there has been no depreciation in the strength of the metal Distortion of the ship from its original circular form is prevented largely by the double curvature (longitudinal and transverse) of the hull surface

We have already remarked that the experimental investigation of the proposed ship brought several agreeable surprises Among these is the fact that a ship with a fairly short and compact hull is much more easily driven than a ship of the typical Zeppelin type Zeppelin believed that for ease of propulsion a long ship of relatively small diameter was necessary and subsequent construction has been guided apparently by that same belief but the navy wind tunnel experiments show that the new plan hull form has a lower resistance for equal volume than any shape hitherto produced The length diameter or fineness ratio of the *MC 2* is only 2 8 to 1 that is to say the metal clad ship is only 2 8 times its diameter in length whereas the *Shenandoah* was 8 6 to 1 and the *Los Angeles* is 7 2 to 1

Early this year in an address before the Society of Automotive Engineers Chief Engineer Upson made an interesting comparison of the new ship with the *Shenandoah* as regards their relative longitudinal strength He states that the worst bending moment for ordinary operation considered in the design data of the *Shenandoah* was reached at an angle of pitch of six degrees relative to the air and at a speed of 60 miles per hour Assuming hydrogen inflation at the blow off pressure of 10 millimeters a safety factor of 1 68 is indicated in the top longitudinal members The *MC 2* (metal clad) under the same conditions except with blow off pressure of 100 millimeters shows a minimum longitudinal factor of safety of 9 61 The fabric covering of the *Shenandoah* offered practically no resistance to bending stresses The instant such stresses were applied the fabric stretched throwing the whole load upon the framework In the metal clad, the outer metal covering assists very materially in carrying such stresses

READY FOR RIVETING

A main longitudinal member lined up in the jigs There are no straight members, all being curved

A HULL SECTION

This shows sections of the longitudinal and transverse members attached to the outer duralumin covering

Looking Up the Chicago River from Lake Michigan

What Lowered the Great Lakes

Jupiter Pluvius, Not Chicago, Mainly Responsible for Low Lake Levels

By J Bernard Walker

FOR the past nine years the level of the Great Lakes has been sinking steadily Look at the diagram at the bottom of the following page showing lake levels from 1860 to 1925 Today they are 27 inches below normal These low levels are causing serious concern—as well they may The Great Lakes' shipping which has carried 110 000 000 tons of freight during the open season is alarmed because the various channels which were blasted or dredged by the army engineers to provide 22 feet of water now show only 20 feet and since ships cannot load to their full draft there is a resulting loss to the carriers of about three million dollars per year Various harbors are similarly affected and if the lowering of the levels continues costly dredging will have to be resorted to Suburban residents alike in the costly mansion and the modest bungalow find that the water which formerly bordered their lawns and grass plots has receded until wide stretches of mud or shingle spoil the appearance of their homes

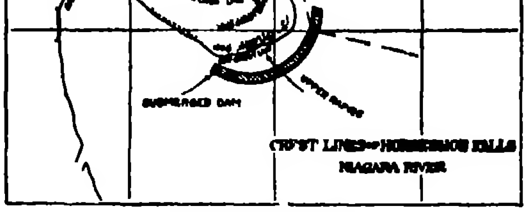
Chicago Not the Culprit

Let us now turn our thoughts to the largest of the lake cities Chicago In the early years of its growth Chicago allowed its sewage to flow into the small Chicago River a few miles in length which empties into Lake Michigan From Lake Michigan Chicago takes its drinking water As Chicago grew in population the inevitable happened and the city was visited by serious typhoid and other epidemics The bacteria got into the drinking water To remedy this condition Chicago dug a large drainage canal 24 feet deep from 161 to 300 feet in width and 28 miles in length from the Chicago River to the Des Plaines River which empties into the Illinois River This in turn empties into the Missouri River The canal was cut with a down grade from the Chicago River to the Des Plaines River and the Chicago River was dredged and widened Hence when the canal was completed the flow of the Chicago River was reversed and the water flowed from Lake Michigan by way of the canal into the watershed of the Mississippi River Today, the water from Lake Michigan flows at the rate of about 8 000 cubic feet per second from the Lake to the Mississippi Basin carrying with it the sewage of a city of 3 200 000 people

The withdrawal of this amount of water has lowered the levels of Lakes Michigan and Huron by five inches

The drainage canal was opened in 1900 and in the eight years that followed there was plentiful rainfall and the drop of five inches was not noticeable Nobody thought or cared anything about the matter But in the year 1909 the level of the lakes began to fall and people began to ask why In 1917 there set in a period of diminished rainfall which has continued to the present day with the result that the lakes are at a lower stage than at any time since 1860 Our diagram showing the fluctuations of the levels in Lakes Michigan and Huron tells the story

Now when it became manifest that there was taking place a steady fall of levels the great cities that border on the lakes and the vast shipping in



TO STOP EROSION

Army plan calls for the submerged dam shown

HOW WATER UNDERCUTS

The erosion causes the overhanging rock to fall

terests began to look for a culprit, and they thought they had found it in the Chicago drainage canal. Thanks to a widespread (nation-wide in fact) propaganda, the public has been led to believe that the whole trouble should be charged to Chicago.

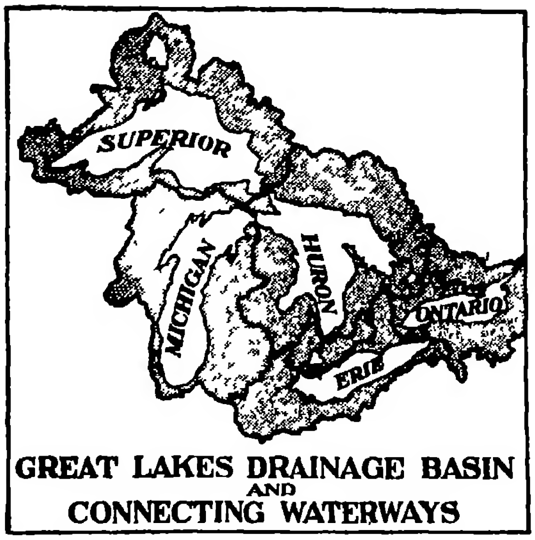
This is unjust, for, as government statistics show, Chicago is responsible for only one-fifth of the shortage—20 inches being due to small precipitation and rather high evaporation, and only one fifth, or five inches, to the water drawn off through the Chicago Drainage Canal. Let us turn to the records of the Weather Bureau. We quote from a recent report by P. C Day, head of the Bureau "The longest period with precipitation continuously below normal over practically all portions of the basins, embraces the last eight years of the period 1917 to 1924. . . . Including 1925, the period is increased to nine years. The average deficiency for the entire watershed during this period was more than two inches per year and ranged up to six inches or more in some portions."

Engineers Can Circumvent Climate

To understand how from two to six inches deficit could have pulled the levels down to the present stage, study our map entitled "Great Lakes Drainage Basin," from which it will be seen that the deficit was felt not only over the lakes themselves, but over the land area draining into the Lakes.

From all of this it will be evident that the lowering of the lakes is not due so much to the struggle of Chicago to solve its portentous sewage disposal problem as it is to climatic conditions.

Chicago is not the only center at which water is being artificially drained out of the Great Lakes. We have before us a letter from the Secretary of War, transmitting letters from Brigadier General H Taylor, Chief of the Corps of Engineers, and reports by Col. J. G Warren and by the Board of Engineers for Rivers and Harbors, dated 1921, from which we learn that the Chicago Drainage Canal was then withdrawing 8,800 cubic feet per second, the Welland Canal 4,500 cubic feet per second, the Black Rock Ship Canal, 700 cubic feet per second, the New York State Barge Canal 1,000 cubic feet



WATERSHED OF THE GREAT LAKES
It is not extensive and drainage to the lakes is small The supply is not great enough for the demand

per second, and the Niagara Power Companies, 50,885 cubic feet per second—all of these withdrawals having their effect upon the level of one or all of the Great Lakes, except Lake Superior The outflow from Lake Superior is controlled by sluice gates, and the level of that lake can be maintained.

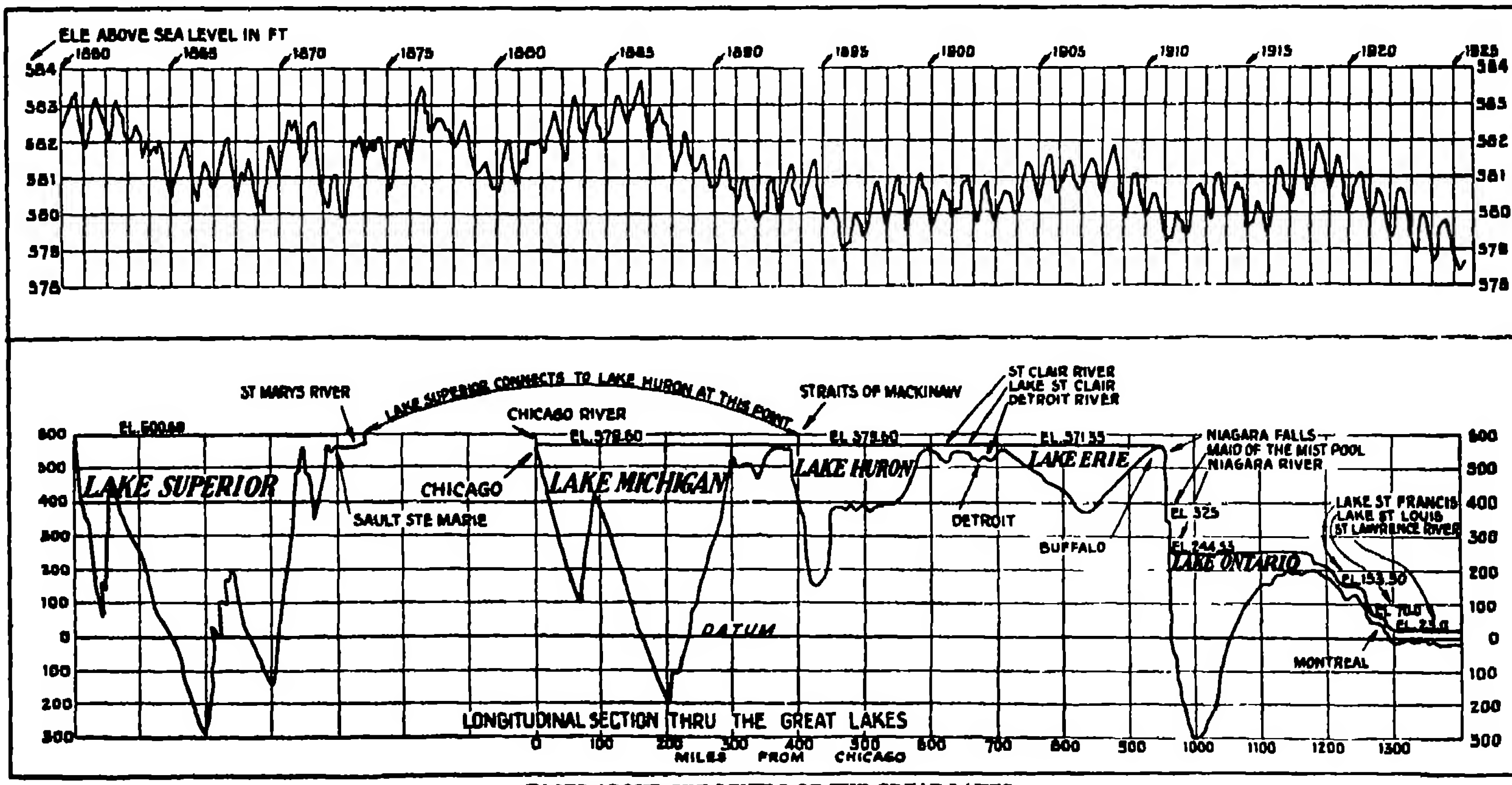
If the raising of the lakes by over two feet was mainly dependent upon the rainfall, the outlook would be extremely alarming, although the Weather Bureau report on lake levels has this to say "It is therefore safe to predict that fluctuations in the amount of precipitation over this region will occur in the future as in the past, and we shall again experience the generous distribution received during the earlier years of rainfall measurement in this region" But, fortunately, we do not have to rely exclusively upon the caprices of the climate, for it is within the resources of skilled engineering to raise the lake levels to any desired stage and maintain them at that stage independently of the rainfall fluctuations. Fortunately, the matter of artificial withdrawal of water from the lakes is under strict federal supervision The permissions to draw water which have been made, were granted as a temporary or emergency measure only, particularly in the case of Chicago, whose permit is revocable at any time The corps of army engineers, which has immediate supervision of this matter, is jealously guarding the interests of all concerned in this matter, and in the report above referred to they urge that no further permits for the withdrawal of water shall be made

But, by far the most important and effective method of raising lake levels is by the construction of submerged weirs at the entrance to the St. Claire River at the southerly end of Lake Huron and at the entrance to the Niagara River These weirs would not present a particularly difficult engineering job and the cost, in comparison with the benefits received, would be comparatively light The natural outflow from the lakes would continue as before.

Niagara Falls in Danger

We present two diagrams showing conditions at Niagara Falls and one of the plans by which the army engineers would permanently restore their beauty. Because of the great amount of water which flows over the center of the Horseshoe Falls, there is a serious and rapid undercutting of the cliff, and at low water, long stretches of the crest line near the Canadian side and near Goat Island are laid bare The army engineers suggest the building of a curved submerged dam a certain distance back of the Horseshoe Falls, for the purpose of diverting a large portion of the flow toward the shoaler portion of the falls and reducing the amount of flow at the center, where the undercutting is taking place. With such a work installed, they claim that not only would the scenic beauty be permanently preserved, but it would be possible to double the amount of water that is used for hydraulic electric power.

In our October issue, we shall deal with the Sanitary District of Chicago and describe the great sewage treatment works which will ultimately reduce the amount of water that will be drawn off from Lake Michigan



FACTS ABOUT THE LEVELS OF THE GREAT LAKES
Upper diagram shows the variation of the levels of Lakes Huron and Michigan. Lower diagram is a longitudinal section showing the depths and recent mean surface levels

From the Scrap-book of Science—Camera Shots of Scientific Happenings

MAUNA LOA LAVA INVADES HAWAIIAN COUNTRYSIDE

The recent eruption of fluid lava from Mauna Loa resulted in the burial of a seaside village. Creeping seaward down the gentle mountain slope this molten river of minerals was irresistible. Houses, walls and other man-made obstructions easily fell before the slow advance of the pasty mass of moving rock. In the illustration it appears to be partly cooled, yet only a few inches beneath the grey face of the advancing wave its color was dull red. The volcanoes of Hawaii are not of the explosive or violently eruptive type

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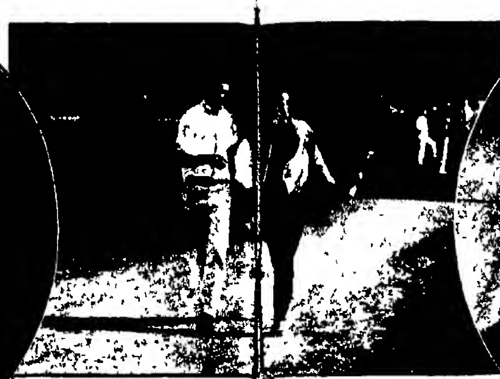
ANOTHER TELEVISION SCHEME

An English inventor, J. L. Baird has devised a system for television over telephone wires. The photograph above is a reproduction of the face of the inventor as it was received during a recent test. The apparatus for transmitting the image is called the "Televisor"



TESTING ATHLETES BY SCIENTIFIC METHODS

Clarence De Mar, long distance runner, subjected himself to tests by Boston scientists, to determine the effect of strenuous exercise on the heart and respiratory organs. De Mar ran 15 miles while physicians made tests on him which may result in some discoveries of great value to many branches of the athletic world as well as to physiology

P & A

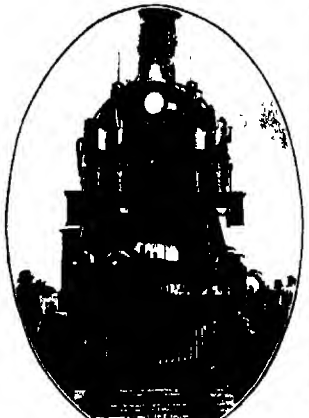
WEARING SMOKE MASK UNDER WATER

Smoke masks equipped with oxygen tanks, such as are now used by firemen in most of the large cities for invading buildings filled with smoke, may be used for underwater work of short duration. The photograph shows a rescue with such a mask

P & A

GOVERNMENT BULB EMBARGO FOSTERS AMERICAN BULB CULTURE

When U. S. Department of Agriculture scientists found plant diseases on Dutch lily bulbs and stopped their importation, a new American industry was made possible. For centuries the Dutch have been famed for their bulbs which have figured in literature and song, being noted the world over. But bulbs that are now being grown in central Florida already rival the perfection of those grown in the Netherlands. When the embargo on Dutch bulbs is raised, can the American grower compete with the thrifty, hard-working Hollander?



International News Reel

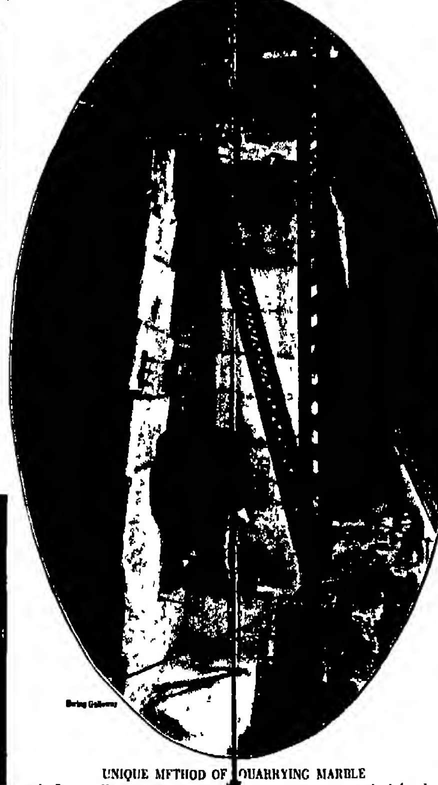
LARGEST THREE-CYLINDER LOCOMOTIVE

Within two years the three-cylinder locomotive has advanced from a novelty to almost a commonplace on American railroads. This photograph shows a new giant of the Union Pacific system. The third cylinder gives more uniform starting torque and increases the overall efficiency of the locomotive. Bearing trouble prevented its previous adoption

International News Reel

AUDIENCE LISTENS TO ONE MAN'S HEARTBEATS

Recently Dr. Richard C. Cabot of Boston perfected a method by means of which a group of physicians or medical students may simultaneously listen to the heartbeats of a patient. The beats may also be recorded with the physician's comment and diagnosis on a phonograph record which may be amplified by means of vacuum tubes



Ewing Galloway

UNIQUE METHOD OF QUARRYING MARBLE

At Proctor, Vermont, quarrying is done below ground instead of by the familiar open-cut method. The mast of the derrick is let into a hole in the ceiling of the quarry, obviating the necessity of providing the usual guy lines. Huge blocks of stone are removed in this way without the necessity of the expensive stripping away of useless overburden

Wide World

RAISING THE SUBMARINE S-51 A "MAN'S JOB"

Unexpectedly, the bow of the sunken submarine rose to the surface in a rough sea, the stern remaining on the bottom. Quick work was necessary to open the flood valves and sink the buoyant pontoons which were crashing together ominously. A navy man boarded the gyrating pontoons and kept the air lines from fouling

Wide World

ARE YOU LEFT-EYED?

The respective sides of our bodies connect with opposite sides of the brain. Professor P. F. Fischbach of Emory University believes that nine times out of ten, left-handed people are also left-eyed. There is a wide difference between the left and right eyes of many persons as they do not always converge on objects in the same way

POTTERY UNEARTHED AT CARTERSVILLE, GEORGIA

These vases show the influence of the higher Indian cultures of Middle America, which spread in modified form over much of North America from this southern source

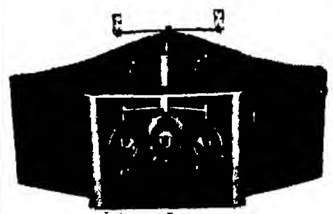
NOTED ARCHEOLOGIST FINDS INDIAN BONES

Warren K. Moorhead, Director of Archeology at Phillips Andover Academy, trowelling out earth where cremated Indian body was found in an urn in Georgia. Dr. Moorhead is the author of a noted work on Indian artifacts and cultures

International News Reel

FUSED QUARTZ, IDEAL NEW MATERIAL FOR THE SCIENTIST

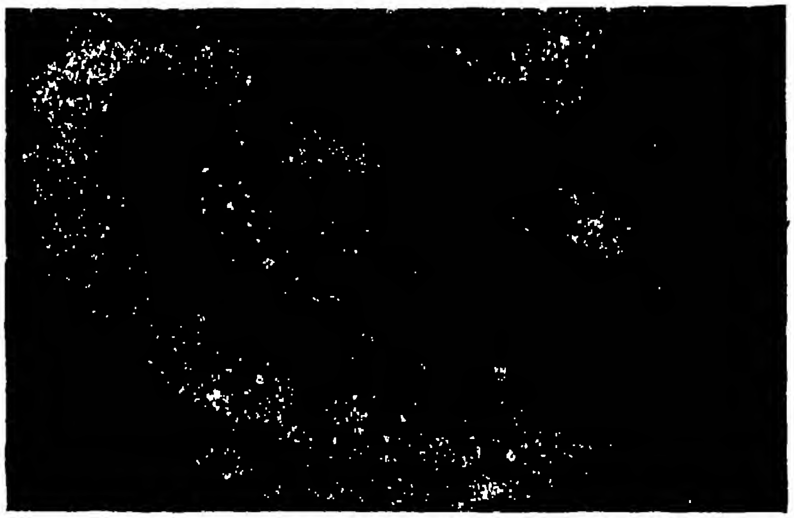
Peter Hidnert, Associate Physicist, U. S. Bureau of Standards who just prepared a government scientific paper on fused quartz, a material which may safely be plunged, red hot, into ice water. Since it contracts little when cooled, it does not break



P & A

TRIPLE CAMERA FOR AIRPLANE MAPPING

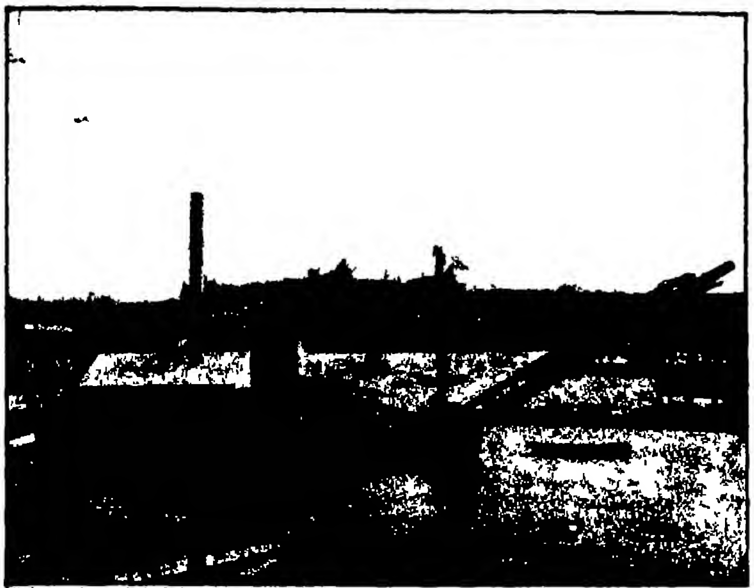
Together these lenses photograph a broad strip of territory near the airplane. The film advances and is exposed automatically as the airplane flies over miles and miles of territory



Photographs through the courtesy of American Museum of Natural History

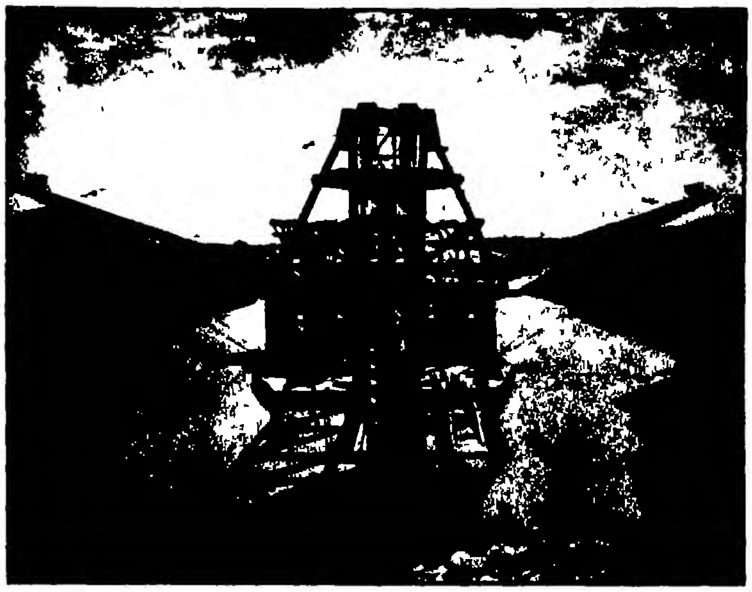
Four Interesting Members of the Reptile Family

Two of the groups in the American Museum of Natural History, are shown at the top and bottom of this page In the center, at the left, is a picture of a crested basilisk and opposite is a photograph of a beaded lizard All of the lizards shown were photographed from life by Professor Raymond L. Ditmars The upper group is known as the rhinoceros iguana group The group was planned by Dr G K Noble of the American Museum of Natural History. The lower picture gives us a glimpse into the home life of the iguanid lizards of Lower California, and shows the great diversity of forms found.



THE FIRST GOLD DREDGE

The first gold dredge built to do, on a large scale, what the individual prospector did with the pan Compare this with the huge machines shown in adjoining illustrations which dig 15,000 yards per day

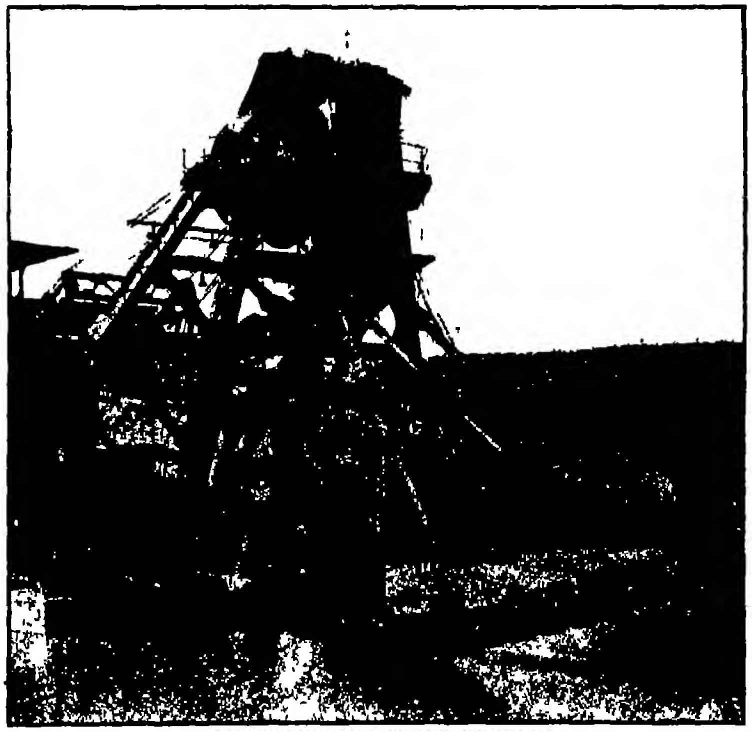


MASSIVE GOLD DREDGE OF TODAY

This huge machine weighing 2600 tons, cuts its own channel through the gold bearing river sands, sifting out the fine flakes of gold and depositing the waste sand in piles on either side of the channel

SIDE VIEW OF FLOATING DREDGE

The endless chain of buckets at the right is scooping up material from the river bed, which is delivered to screens within the hull where the fine gold bearing sand is retained and the gold extracted



FRONT END OF LADDER DREDGE

This ladder can be lowered to work at a depth of 81 feet Each bucket weighs two tons and can scoop up 14 cubic feet Each boat can handle 15,000 cubic yards of the gold bearing gravel per day

Huge Gold Dredges of the West

The world's biggest digging job is under way on the Yuba River—the historic producer of millions of dollars in the days of the California gold rush. In this region, six gold dredges, successors to the "forty-niners" and their "long Toms" have dug 340,000,000 cubic yards of material, and a survey of the gold-bearing sands shows that they have ten years of digging ahead of them Already, six of these great dredges, each costing from 700,000 to 1,000,000 dollars, have recovered 50,000,000 dollars in gold. The pioneer miner, working in the California stream beds, was able to dig and put through his sluice box only a few cubic yards of the gold bearing gravel in one day, but each of the modern gold dredges, working 24 hours a day, handles 15,000 cubic yards, that is to say, it does the work of many thousands of the pioneers of '49. Briefly, the gold dredge may be described as a bucket elevator mounted on a pontoon or barge, with an opening or well at one end through which an endless chain of buckets is operated The buckets pass over a large circular tumbler at the lower end of the digging ladder and the entire bucket line is operated by a power-driven sprocket or tumbler at the upper end of the ladder The ladder is hinged at its upper end and its lower end may be raised or lowered as desired The buckets carry the gravel up to a hopper from which it passes into a revolving screen which separates the gravel from the gold bearing sand The coarse material is then conveyed to the rear of the boat. The fine gravel and the sand pass over riffles or tables, where mercury amalgamates with and saves the fine gold The dredges are of massive construction The ladder weighs 250 tons and the lower tumbler 20 tons

THE VILLAGE WHICH HAS FURNISHED MARBLE FOR NEARLY ALL THE SCULPTURES OF THE MODERN WORLD

The white drifts that look like snow on the sides of the hills are really the unused fragments of brilliant white marble thrown out on the dumps of the many quarries

Snow-white Marble of Carrara Still the Best

THE great sculptors of antiquity worked under a double handicap. The rules of their art were still to be formulated and, worse still, they had to search out and test their own materials. The first really suitable stone to be discovered was the marble of Mount Pentelicus, in Attica. From this marble were made the famous sculptures of the Parthenon, in Athens, most of which were removed to the British Museum by Lord Elgin. Another famous ancient marble was that of the Isle of Paros. Best of all, however, is the marble of Carrara, a small town in southern Italy. This marble was discovered in Roman times but was then called Lunan marble, from the Roman town of Luna, close by. After the fall of Rome, the Carrara quarries were abandoned for centuries, until the architectural renaissance of Italy in the Twelfth Century. Since then, most of the great sculpture of the world has been done in this Carrara stone.

In the mountains near Carrara all the factors of earth history have combined to produce a stone of extremely uniform texture and color and broken by very few fractures. The largest blocks of perfect marble ever quarried have been obtained from these beds. Among the six hundred or more separate quarries which have been opened in these mountains, only a few produce the very best grades of marble. In other places the original chalk was not pure enough and the marble lacks the clear white color which makes it so much admired.

Since the World War, the graves of the many thousands of American soldiers who died and were buried in France, have been marked by temporary wooden crosses, "row on row." For some time past, the American Battle Monument Commission has been thoroughly investigating the numerous available materials with which to replace these crosses in order that they may endure indefinitely. American granite —hard, durable, but expensive—was given consideration, but Carrara marble was finally chosen because of its beauty, greater accessibility and because it could be worked comparatively easily.

HOW THE MASS OF MARBLE LOOKS IN PLACE

Quarrymen carefully study the surface of each exposed layer, to determine just how large solid blocks can best be cut from it

MODERN TRANSPORT INVADES THE QUARRIES

Automobile trucks now take the place of the thousands of slaves, mostly captives of war, whose labor worked these and other quarries in Roman times

FVEN HOUSES ARE OF MARBLE

mall fragments of marble, even of the best quality, are so common in Carrara that anyone can build his house of them

GREAT BLOCKS DESTINED FOR WORKS OF ART

The Carrara marble is roughly dressed on the spot and then shipped to sculptors and builders all over the civilized world who use it in the production of beautiful works of art

AT TIMES THE ANCIENT MODE OF TRANSPORT STILL PROVES TO BE THE BEST

Although motor trucks and railroads are now used to handle the output of the quarries some of the largest solid blocks are still hauled down from the hills for shipment on enormously strong wagons, drawn by spans of oxen, just as was done when Michelangelo was using the Carrara marble for his greatest works

Novel Devices for the Shop and the Home

A Department Devoted to Recently Invented Mechanical and Household Appliances

Conducted by Albert A. Hopkins

The clasp releases the cake

English Cake Pan

WE are apt to think that our English brethren lack invention when it comes to household articles but this is not the case as is shown by the illustration of the cake tin with a split rim. When the cake is baked, the pan is removed from the oven, the clasp is loosened and the cake easily released from the metal ring.

The miniature piano is more than a toy although its range is small

A Portable Piano

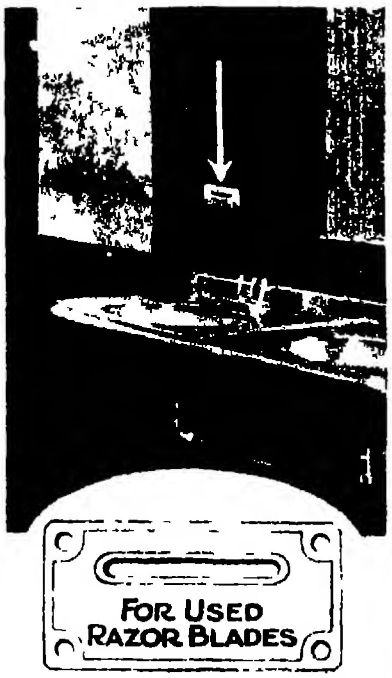
AN inventor has come forward with a piano which is so portable that it can be carried in an automobile with ease. The results obtained from this miniature piano are excellent although of course not comparable to those obtained from one with 88 notes. This piano is provided with a *removable unit carrying the strings and action*, another unit carrying keys of usual width and a third unit comprising the collapsible frame. It can be readily carried by one man from place to place and can be easily taken apart and packed in three bundles. It can be reassembled in a very short space of time. The sounding board, the strings, the damper, the hammers and the actuating rods for the hammers are all mounted as a single unit which may be placed between the side frames so as to in itself form the back of one half of the rear of the piano. The keys and the carrier upon which they are mounted form another unit which can be slid into place.

A great labor saver in roadbuilding

Finishing Concrete Roadway

ROADBUILDING is simplified by this machine. The concrete is deposited between steel side forms set for the proper width of the slab which is to be made. The finishing machine rides on these side forms. The concrete is roughly leveled by men with shovels, then the machine moves away under its own power, striking off the concrete to the proper level and giving it the correct crown for the road. Behind is the tamping board which helps eliminate a portion of the air and water in the concrete giving a denser slab. Behind the tamping member is the belt or float. This mechanically smooths the pavement.

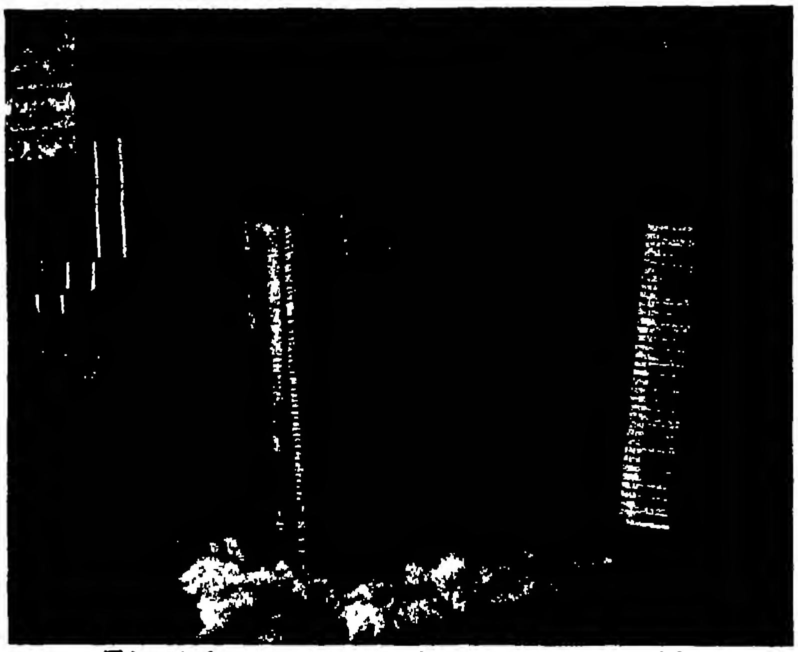
Slipping the cake from the pan



Eternal rest for old razor blades

Razor Blades in the Sleeper

CARELESS travelers were always throwing safety razor blades into the towel racks on sleeping cars causing serious cuts when the porters emptied the towel receptacle. To obviate this, the Pullman Company supplied a little bag for the waste blades, but the manufacturers complained that the blades would be sold by the porters and resharpened. Therefore a slot was cut in the side walls and the blades were allowed to drop between the outer and inner skins of the car. In a short time, there would be nothing but a small mass of rust.



This articulate piano can easily be carried in an automobile

A Visible Corn-Popper

WITH the ordinary corn popper, it is necessary to open the popper from time to time to note the progress of the bursting grain. With the device shown popping is rendered easy as the corn is visible at all times.

A glass cover for the popper

Placing ball in die

Re-covering Old Golf Balls

EVERY golf player would like to re-cover his old golf balls. An outfit has now been introduced which makes new golf balls out of old ones that have had the covers cut. Our illustrations show the sequence of operations.

First the old cover of the ball is removed. A new cover which comes in two pieces with the repair outfit is placed on the old core. This is put in a two-piece die which is then clamped tightly together so that the covers of the ball fit closely. Then the die is placed

Removing newly covered ball

in hot water. This unites the two parts of the new cover. The whole is removed and cooled, and the die is taken apart by means of thumb screws. The ball is removed, scraped to take off any uneven portion where the two parts of the cover meet. It is then painted and after drying thoroughly it is ready for use on the golf course.

Safe sanitary milk holder

A hundred horsepower ice omnibus

Hinged Rack Facilitates the Removal of Package Cage

IN making delivery of packages for one of the large stores in San Francisco, a service company has had a number of cages built which fit into the body of the truck as shown in the illustration. On arrival at the sorting plant, the truck which carries the cage is backed up to the unloading platform. The cage is mounted on four casters. These run in a metal groove attached to the floor of the truck. When the cage is to be unloaded the hinged racks shown at the back of the truck are lowered so that a continuous track is provided for wheeling the packages in the cage from the truck to the unloading platform where bulk may be broken.

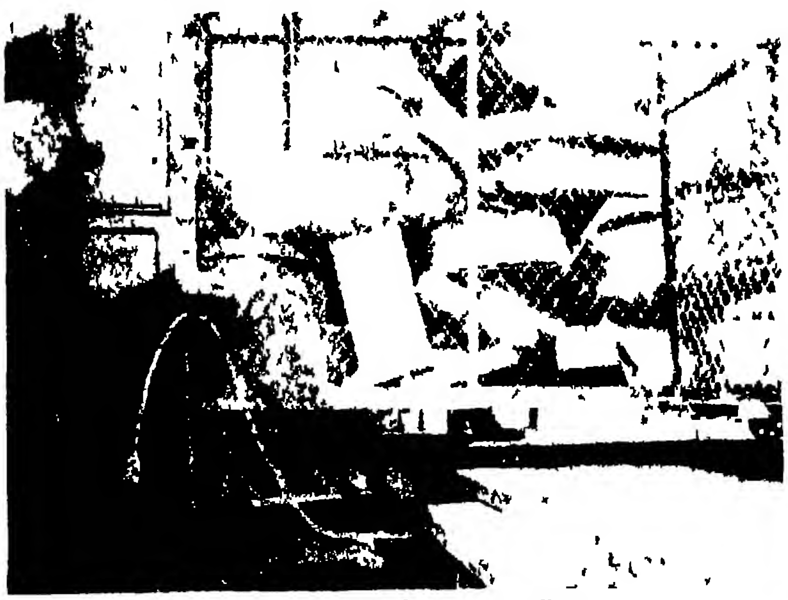
An Ice Omnibus

THIS curious vehicle is capable of transporting ten passengers over the ice. It is moved by an airplane propeller of the "push" type and is capable of making high speed. The motor is of 100 horsepower.

The hinged rack folded against the screen

Clean Milk Insurance

CLEAN milk is assured by the use of a metal milk bottle container shown on this page. The paper caps are protected from dirt, dust and from dogs. It holds messages to the milkman and keeps them protected from rain and snow. The device is very reasonable in price.



Rack down to allow the truck to roll out

Putting the die in hot water

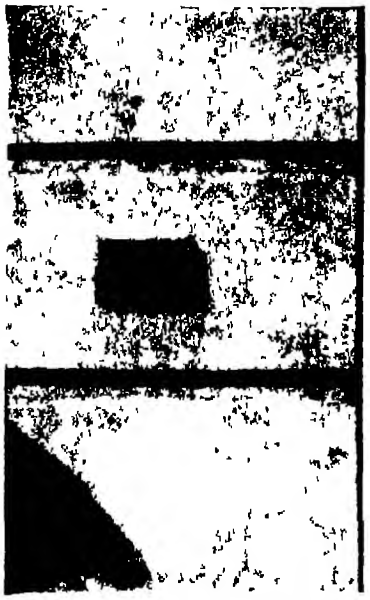
An Expanding Reamer

BY using the cylinder reamer shown on this page an unusual amount of flexibility of the blades is made possible. When expanded the blades do not enter the cylinder wall at the insertion as the cylinder is held. The reamer is stationary but rests firmly against it until the device is revolved. During the first quarter revolution of the reamer the blades are gradually fed to the full depth and are sustained there by the spring tension against the upper retaining collar. The expansion and contraction of the blades are effected by the longitudinal

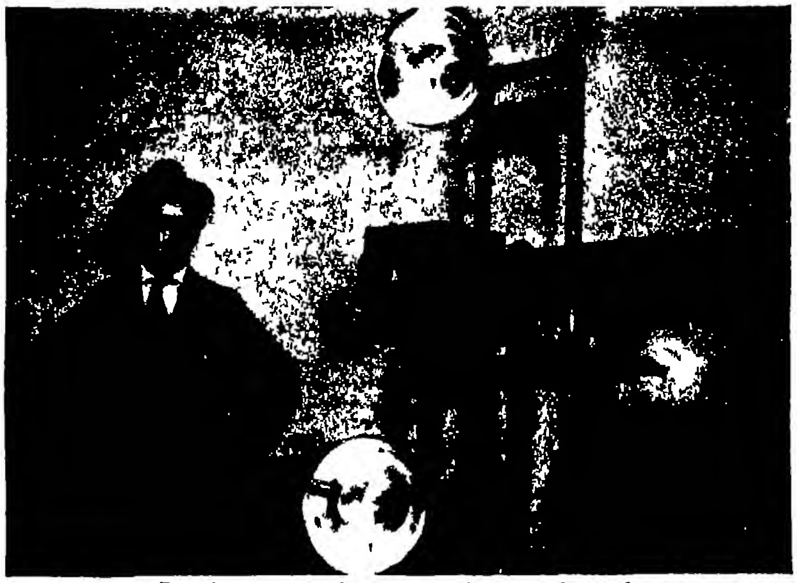
Painting the ball with enamel

movement of sliding spindle which has provided with two long separate tapered seats to support the blades. The movement of the spindle is brought about by adjusting the nut located at the top end of the reamer. There is a graduated dial to record correct expansion in thousandths.

Expanding reamer for cylinders



"Peep-hole" for viewing the vault



Details of the mechanism for observing the vault

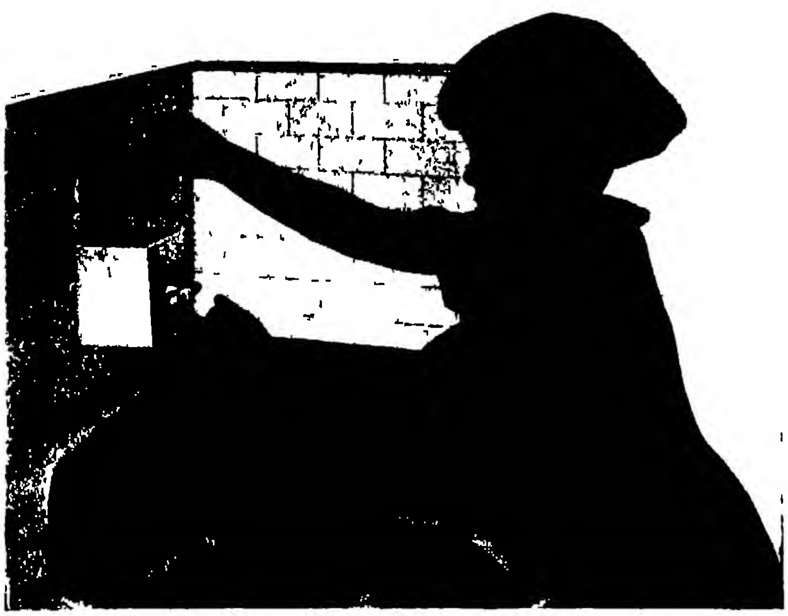
A steam double boiler

Making It Hard for the Burglar

A BANK in Portland, Maine, has installed a periscope as a defense against bandits and burglars. The optical mechanism is concealed within the walls of the vault and has an outlet on the exterior of the building. A small "peep-hole" enables the policeman on the beat to see the interior of the bank vaults even though they may be below the street level. A system of lenses and prism enables one to see the entire interior as well as the entrance of the vault so that no one could even approach the door without being seen. The "peep-hole" is imbedded in bronze set in the masonry on the street level.

Saving the Soap

IN nearly every household, a considerable quantity of soap is wasted each year as almost anybody will refuse to use a small piece of soap. A device has now been introduced which does away with this waste. It turns small pieces of soap into powdered form a little at a time as needed and uses it all to the last crumb. All members of the family can use the same cake of soap without the cake ever coming in contact with the hands. All you do is raise the lid of the soap holder and turn the handle. The soap is cut by knives to a powder. Any soap except the softer grades may be used.



Even children enjoy powdering the small pieces of soap

A Self Contained Loader and Shovel

ONE man can efficiently operate this combination shovel and crane-loader built onto a tractor. In digging operations, the tractor moves ahead and the bumper forces the shovel into the pile of material. The massive rear axle of the tractor absorbs all the digging strains. A load may be dug raised, swung and dumped in an average of thirteen seconds. This is possible because no unnecessary backing up and turning is required. As the shovel of the machine raises to its full height it knocks a clutch out and throws a brake on automatically.

Cooking by Steam

THE cooking device which we show has been on the market for several years but it is so efficient that it is worth illustrating. Steaming is the best method of cooking many foods, as, for example, cereal, bread, macaroni, egg, milk and cheese dishes, fish and some meats. The device shown consists of three parts: a food pan which fits securely over a water pan and a cover which fits both. Holes near the top of the food pan admit steam directly in, upon and around the food. Herein lies the difference between the ordinary double boiler where the food pan simply extends down into the water pan. Drain holes in the rim permit the steam which condenses on the cover to drip back into the water pan.

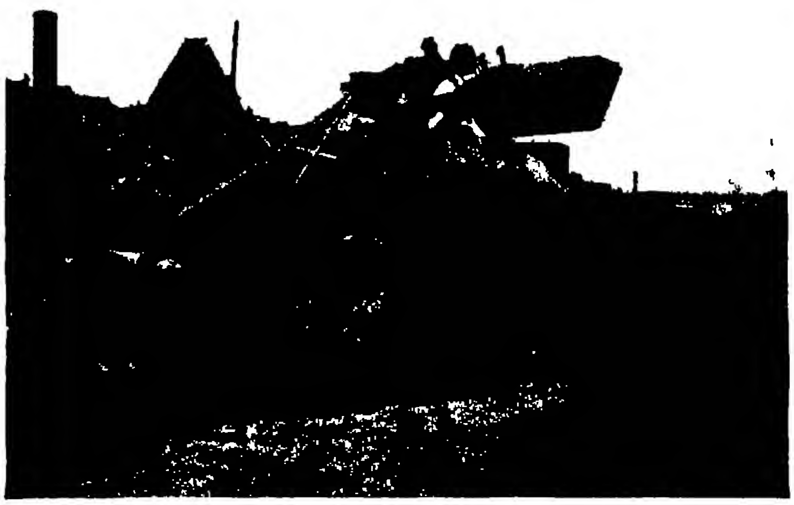
A Shaving Brush and Beard Softener

THIS shaving brush has three functions, first to prepare the face for the lather, second to apply the lather itself, and third, to massage the face after shaving. The handle is set at right angles to the brush, thus keeping the lather away from the hands. After shaving a delightful healthful massage can be given by washing the lather off the rubber "fingers," dipping them in clean water, and rubbing over the face until the skin glows and tingles. Lastly, the lather brush should be thoroughly washed given a few quick shakes and hung up to dry.

Celluloid for Draftsmen

THIN sheets of celluloid are coming into use as a substitute for tracing cloth as it has been found that this is especially useful for the recording of data, maps or diagrams, particularly those which are subject to frequent revision and much handling. The celluloid which is usually employed for this purpose has a matt surface on one side. The sheets are not rolled up but are kept flat so that they are easily stored in vertical filing cabinets or in large drawers. No separators are needed between the sheets of celluloid.

Applying the lather



A crane-loader and shovel combination attached to a tractor

Massaging the face

The Scientific American Digest

A Review of the Newest Developments in Science, Industry and Engineering

Conducted by Albert G. Ingalls

Talking Motion Pictures

IN our July issue we described a new kind of motion pictures that talk (page 53). A wax disk, somewhat similar to the ordinary phonograph record, and bearing in its grooves the records of the incidental music of a moving picture, and some of the incidental sounds, was perfectly synchronized with the picture film.

Since then we have had the opportunity to see—and hear—these remarkable pictures at a private showing given in New York by the Western Electric Company and Warner Brothers Pictures, Inc., the two groups which have cooperated in the development of this new art. First we saw as well as heard Will Hayes so-called "Czar of the Movies," making a short announcement concerning the future of the talking motion pictures. The synchronization between the lips and voice was perfect while the voice and intonation as well as the other acoustic properties were as nearly perfect as a fine radio set, for example, would have rendered them. Then we saw a scene from "I' Pagliacci." The clown moved and sang in perfect unison, so that the illusion of his presence was well nigh complete.

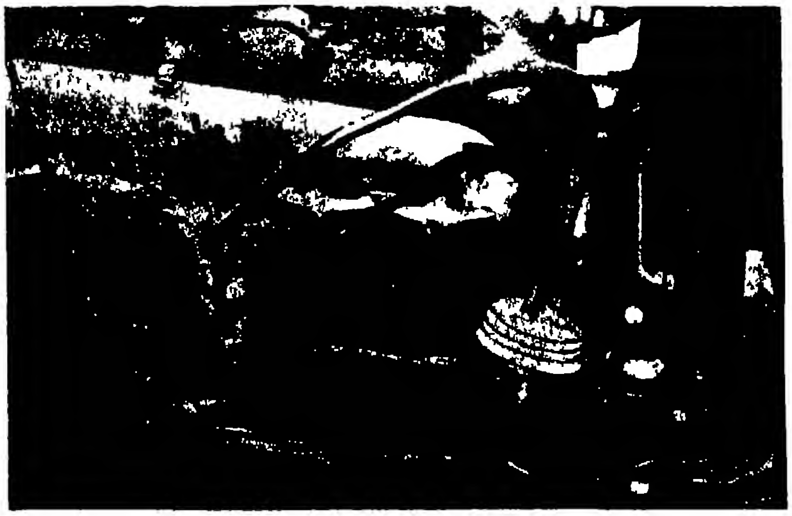
But odd as it may seem to the reader, the new method is not ordinarily to be employed for reproducing the voices of the actors of the motion pictures. This could be done, but it is not commonly desirable. People have become accustomed to keeping track of the plot through a study of the pantomime, and with the aid of sub-titles interspersed wherever necessary. By reproducing the speech of the actors the fine art of pantomime would be brought to naught and an element of the commonplace, a jarring note, would often be introduced. Therefore in a third moving picture which we witnessed, "Don Juan," with Barrymore as the star, the usual printed sub-titles were used. When, however, the wedding bells chimed in the picture their actual notes were reproduced by the speaking device, but at all other times the accompaniment was that of a full orchestra—in the present instance, that of the famed New York Philharmonic Orchestra of 103 pieces.

Thus, in effect, the talking moving pictures should bring the large picture houses of Broadway, with the splendid incidental music of their large orchestras, to much smaller communities. Certainly a picture is more thrilling, more enjoyable when thus accompanied, than one run off to the tune of a piano played by a bored musician. During the entire demonstration the acoustics were excellent. The material in the phonograph disks is much softer than in those used in commerce and thus many objectionable qualities of the latter are largely eliminated. The sound is amplified by means of an apparatus similar to that used with radio sets but more powerful and it issues from special concealed megaphones.

The mechanical apparatus is remarkably simple. The shaft that drives the film is positively geared to the shaft that drives the wax record. Operators, we are informed, are to be trained by the manufacturers, the course requiring a few weeks. The entire equipment is said to cost less than that of a pipe organ, and regular service is to be begun as soon as the new equipment is ready for distribution.

Thus one more advance in the art of entertaining is initiated and we may see the last of the squeaky fiddle and ill tuned piano of the old fashioned type of moving picture house.

The oil rectifier as incorporated in a Packard Eight. The inventor is shown pointing to the rectifier



The original oil rectifier, described on this page, and used in the early experiments, was nothing more than a Mason fruit jar, installed on a Ford car

* * *

Keeping Gasoline Out of the Crankcase

As every motorist knows, oil pumping in an engine is caused by the vacuum in the combustion chamber pulling oil up past the piston rings. How to prevent this costly and damaging fault was an unsolved problem that harassed automotive engineers for a quarter century. Six years ago, it developed that if the same vacuum could be created in the crankcase, *below* the pistons, the passage of the oil upward would be stopped and the oil pumping eliminated.

Experiments along this line disclosed a new objective vastly more important and interesting than the original. Not only could oil pumping be prevented, but conversely, *all* oil troubles could be eliminted by keeping *dilution* out of the crankcase.

The evolution of this idea and its development can best be described by briefly tracing the experimental work of the past six years—a history which aptly demonstrates how failures in experimentation can often be turned into eventual success.

In the first attempts to place a vacuum in the crankcase, a vacuum pump was used. But inasmuch as the crankcase could not be made air tight, a very large pump was required. It was soon discovered that this large pump pulled oil from the back main bearing of the engine and bearing failures resulted. The theory was wrong.

Further experiments proved that a vacuum could be applied directly to the pistons by drilling a hole through the cylinder wall at such a point that it would register with the lower piston ring when the piston was at the bottom of its stroke. Applied here, the vacuum of the intake suction would be sufficient to draw off the oil on its way up to the combustion chamber.

In order that the oil might be easily withdrawn through the hole in the cylinder wall, a groove was cut around the piston immediately beneath the lower ring. This should trap the excess oil and permit the intake suction to remove it each time the groove came opposite the hole in the cylinder wall.

Weeks of experimenting finally proved that this method was not removing enough of the surplus oil—for the same reason that a liquid cannot be poured rapidly from a sealed can in which but one hole has been punched. An inlet for air as well as an outlet for oil was needed. This difficulty was surmounted by drilling a small "bleeder" hole through the wall of the piston, opposite the hole in the cylinder wall.

At last, enough oil could be removed greatly to curtail engine smoking. The first objective was achieved.

Having found that the excess oil could be removed from the piston thus preventing it from reaching the combustion chamber, the next problem was what to do with it.

At first an ordinary Mason fruit jar was used to collect the oil removed from the pistons. The first time this jar was tested on a Ford car about five miles had been run when the car suddenly began to smoke excessively. The oil removed from the pistons was being carried into the intake manifold. The quart jar was full! (Of course a large percentage of the contents was gasoline trapped on its way down to the crankcase, but the importance of this fact was not realized at the time.) After considerable experimenting an automatic device was developed to replace the Mason jar and to allow the surplus oil to be returned to the crankcase by gravity.

The system was now fairly successful. But it did not accomplish the economy nor obtain the oil mileage that had been hoped for, particularly at high engine speeds. Finally, the idea was hit upon of removing the oil, not from an extra groove cut around the piston, but from behind the lower piston ring or the bottom of the lower piston ring groove. Removing the oil from back of the ring proved so successful that it was made a permanent feature.

Some of the first test installations were made on tractors to determine just what oil saving could be achieved on that type of internal combustion engine. The primary object was to eliminate oil pumping and its train of evils. It was discovered however, that after these tractor installations ran a few hours the oil did not thin out so readily. Dilution was being cut down automatically because the more volatile elements in the mixture drawn from the pistons were being vaporized, drawn back into the combustion chamber and consumed while the heavier liquid oil was returned to the crankcase. Here the idea of systematically preventing crankcase dilution was born.

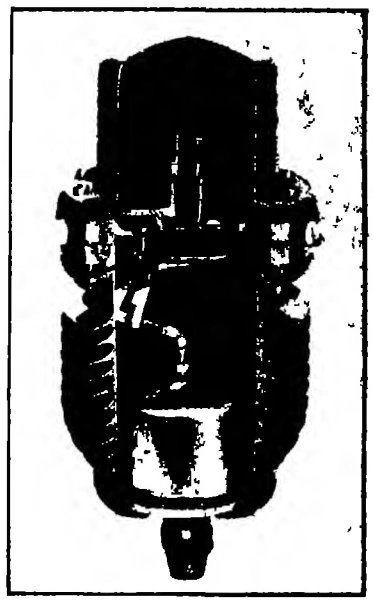
Installations using heat to distill the mixture were now made on six different tractors with excellent results. It was found that instead of changing the oil every thirty hours, tractor engines would operate as long as 350 hours with the oil remaining in good condition.

At this point in the development, it was suggested that a more practical plan of eliminating crankcase dilution would be to remove the oil from the crankcase itself instead of from the pistons and then to pass it through the rectifier or separating device. This method was tried but with little headway. Dilution passed by the pistons into the crankcase just about as rapidly as it could be removed.

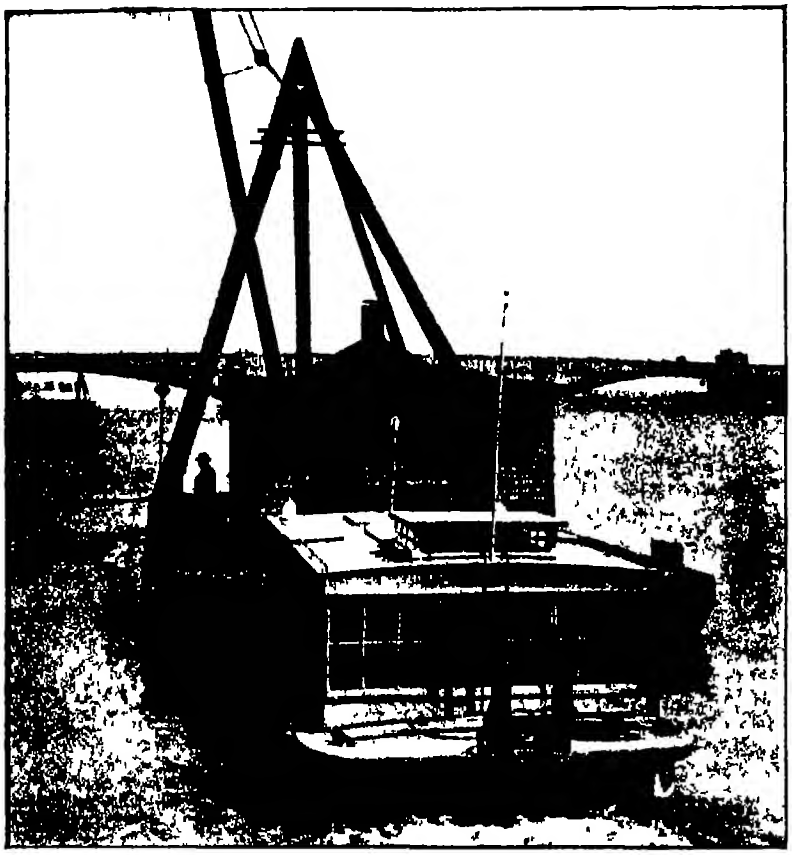
Abandoning all experiments with this type of rectifying system the first idea was again tried of removing the contaminated oil from the pistons, heating it and then conducting it to the rectifier for purification. In other words it was far more practical to *prevent* crankcase dilution than to attempt to cure it.

Next the rectifier was tested on a standard automobile engine. This test was made indoors under ideal temperature conditions. A mixture of 35 per cent kerosene, 10 per cent water and 55 per cent oil was placed in the crankcase. In two hours the water was gone and in ten hours the dilution was down to 5 per cent. Apparently the device had been perfected.

But when the same engine was taken outside and placed in a chassis the results were disappointing. Dilution could not be prevented except when the car was operating at high speeds and when the motor was hot.



Cut-away section of the rectifier. The white arrow indicates the thermostatic valve which keeps the oil cool



The caterpillar tugboat towing a derrick float. The two separate hulls may be seen beneath the deck. The wash is from the endless chain contrivance which lies between them and carries the perforated paddles

Further experiments showed that the method of heating the contaminated oil at one point and then conducting it to the rectifier for separation at another was entirely wrong. The vaporized impurities had a tendency to recondense and again pass into the oil. It was then decided to combine the heater and the rectifier. With a rectifier of this nature a test was run on a Ford car in which the fuel tank was filled with kerosene. Gasoline for starting only was drawn from an auxiliary tank. This car was run about 500 miles on kerosene alone with a maximum dilution of 6 per cent. Combining the rectifier and heater had proved to be the ideal method of removing the dilution. This was the correct solution.

One problem still remained. While maintaining sufficiently high temperature in the rectifier to separate the volatile gases from the oil it was necessary to prevent the oil itself from becoming overheated. A thermostat was finally devised which at a predetermined temperature would open a valve and permit the oil to drain out of the heated compartment of the rectifier into the crankcase. This proved to be the desired solution and the adoption of this method which is called the Skinner system by the leading car manufacturers, followed in due course.

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A Caterpillar Tugboat

SHALLOW water navigation has made little progress since the days of the old stern paddle wheel steamers. The reason is readily apparent in that the units of transportation must be kept relatively small on account of the impossibility of increasing the power—which in this case means increasing the size of the wheels—because of the limitations prescribed by wheel losses in shallow water, where power is most needed because of hull resistance.

What promises to revolutionize towing is seen in a new type of tugboat which is in substance two pontoons with an endless-chain contrivance located between them, patterned very closely after the belts of a caterpillar tractor but with the necessary paddles attached. In fact this is a water tractor towboat. The advantage of a horizontal thrust throughout the entire length of the belt is demonstrated in the towing ability of this novel boat. Perforations in the paddles give the accumulative effect of the same principles as were explained in connection with an oar on page 368, June, 1925, issue of the Scientific American. The great advantage here is that as these paddles slip through the water, the holes or perforations therein allow enough water to pass through them so that one paddle does not rob the other of the amount of water required to give it sufficient grip to develop power. There is absolutely no suction as close as six inches in front of these paddles, all the water being supplied from underneath. A solid paddle operating on an endless chain becomes very inefficient when the slippage through the water is more than four miles per hour. Here apparently a vacuum is created in front of the boat and the water rushes in between the pontoons almost as rapidly as it comes out at the back. With the perforations, however the point has not yet been found where any power is lost, no matter how fast the paddles slip through the water.

Another point in favor of the perforated paddle and the direct backward thrust is that when the boat is in operation where the paddles come within ten inches of the bottom the sand or mud is not disturbed. This would tend to show that retarding eddies are not set up by the "churning" of the paddles.

Here is one of the strong features of this type of propulsion and it explains why operation is more efficient in shallow water than with the old type propeller or even the radial wheel.

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"The Splendour of the Heavens," a Notable New Book

HAVING completed a careful reading of the entire 976 pages of "The Splendour of the Heavens" the writer feels at a loss for adequate superlatives with which to characterize it.

This book is called "a popular, authoritative astronomy." Each of these words appears to have been thoughtfully chosen. It is popular without being too popular. It is as authoritative as one has a right to expect when told that every one of its 19 co-authors is a member of the *Royal Astronomical Society*, and that the secretary of that famed old association of astronomers acted as one of its editors. It is an astronomy in that it covers practically all the ground that a general astronomy should cover (except the purely study book subject of astronomical reference points, lines and positions). It is not however a text book, but rather a book to be read, chapter by chapter, with keen interest.

Perhaps the most noticeable feature of "The Splendour of the Heavens" is its remarkable collection of astronomical photographs and drawings, 524 of them each of which bears an explanatory legend of ample length.

We must not, however, give the impression that "The Splendour of the Heavens" is only a picture book. The text is far from superficial although it is sufficiently non-technical for the comprehension of the average intelligent person. After reading it one ought to have a pretty good idea of the whole field of astronomy, without of course, having delved too deeply into any one part of it.

Of the two handsome volumes the first is entirely devoted to the solar system, including well rounded discussions of the present status of the problems of Mars, Venus, the moon and of comets and falling stars. Here as elsewhere each contributing author was especially chosen because he had previously specialized on his subject.

The second volume is chiefly devoted to that marvelous rebirth of modern astronomy of the present century, which has carried our knowledge of the universe almost infinitely beyond the neighborhood of our own solar system. A few of the interesting chapter headings are: Finding the Scale of Space. The Message of Starlight (brief explanation of the immense significance of stellar spectroscopy), Star Clusters and Nebulae, The Structure of the Universe, The Amateur at Work (53 pages concerning worth while work which the amateur astronomer can do).

The last 140 pages of the second volume are working pages for the amateur who uses a small telescope. The map of the moon reproduced in 25 sections is undoubtedly the best in existence while 525 lunar formations are named and described in notes. The 36 large-scale charts of the constellations constitute a star atlas in themselves. All of the "show" objects of the heavens are described and located, and there are lists of interesting objects, such as variable stars, double stars red stars, nebulae and so on.

"The Splendour of the Heavens" (McBride, New York, 1925) is well suited to those who are making telescopes in connection with the telescope-making campaign which is now being carried on by the Scientific American. It would whet their appetites for astronomy and teach them what uses they may expect of their telescopes. It is somewhat expensive ($12.50, plus postage) but the large size of the work (the pages measure eight by eleven inches) its fine binding, smooth paper and general attractiveness make it well worth the price asked by the publishers.

One might safely challenge anyone, no matter what his previous training or present interests to open either volume without poring over it for hours.

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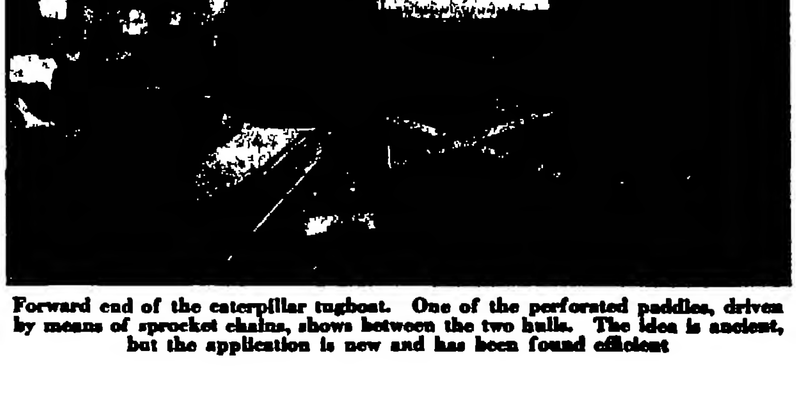
A Study of the Dardanelles Expedition

MANY are the books which have been written for the purpose of embodying the lessons of the World War and doubtless there will be many more. Here and there in this ever-accumulating literature, there stands out a work which because of its clarity forcefulness and the analytical power displayed, carries particular value. In such a class belongs "The Dardanelles Expedition"—a condensed but complete analysis of that ill fated venture written by Captain W D Puleston, U S N.

So far as the civilian reader is concerned, the fault of much of the war literature is its bulkiness and over-elaboration of detail, but to any one who is looking for a concise, clear and thoroughly understandable story of the complicated Dardanelles expedition we heartily commend this book.

In the preface to the book Captain Puleston writes, "This account of the Dardanelles expedition is primarily intended for army and naval officers, but it is hoped that it will be found worthy of the brief notice of American statesmen who may be required to direct the destinies of our country in time of war. All three classes are busy men, so the narrative has been compressed and fully illustrated in order that its contents can be quickly understood."

The work commences with a brief but comprehensive review of the history of the political background of the war including a review of the history of Constantinople which was, of course, the great objective of the Dardanelles expedition. It then shows the events which led up to the various naval attacks with which the campaign opened. Then, in their order follow descriptions of the successive attempts to silence the forts and force the passage of the Straits. The most thrilling part of this narrative deals with the landing of the British and French troops and the curious but unavailing attempts of the army to force its way through the hot and arid defiles and obtain possession of various commanding positions. The work ends with the withdrawal of the British forces under the cover of night without the loss of a single man.



Forward end of the caterpillar tugboat. One of the perforated paddles, driven by means of sprocket chains, shows between the two hulls. The idea is ancient, but the application is new and has been found efficient

A notable feature of the work which makes it possible to follow both the naval and landing operations with full understanding, is the large number of specially prepared maps which are included with the text, each map being in juxtaposition to the chapters that treat of the particular map concerned.

The Dardanelles expedition was a major operation, even in a war as great as this. The British employed over 400,000 men during the campaign, of whom they lost 120,000, and to this must be added the French losses, figures of which are not available. The Turks employed 800,000 men and lost 218,000. There is a touch of humor in the following paragraph at the close of the chapter on the evacuation of Gallipoli: "The southern Turkish forces twitted the northern forces for permitting the British to escape unscathed, to which the northerners responded: 'You know now Helles is about to be evacuated. Let's see you stop them!' On January 9th in spite of repeated warnings and some last-minute bad weather, the southern Turks were as powerless as their northern brothers to prevent the departure of the British from Helles."

The book, which is handsomely bound in red buckram, contains 154 pages and 68 plates. The price is $2.50 and the work is published by the United States Naval Institute, Annapolis, Maryland.

* * *

New Proof That the Sun's Heat Varies

A DEVELOPMENT which bids fair to rank high in weather forecasting is announced in the latest issue of the Monthly Weather Review of the United States Weather Bureau, by Dr. Charles G. Abbot of the Smithsonian Institution, says the Science News Service of that institution. That development is the discovery of a new and simple proof by Dr. Abbot that the amount of heat given off by the sun from day to day and from year to year varies.

If the proof is final—and it seems irrefutable—there can be no further question that the sun is a real factor in the daily and yearly weather changes. Exact appraisal of its value for long range weather forecasting awaits only the further perfection of measurements of solar variation and world weather. At all events, an essential element new to weather forecasting has been discovered and proved. Its application is only a matter of research and time.

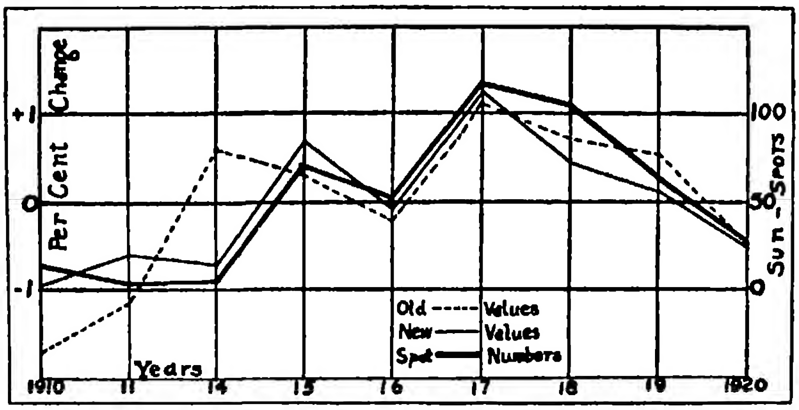
For 30 years, Dr. Abbot has been investigating the sun and measuring the heat it sends to the earth. In 1903 he surmised from his results for previous years that the amount of that heat varied. Urged on by that clue and its great significance to mankind if true, he has spent the intervening years in elaborate measurements of solar radiation in many parts of the world at Mount Wilson and Mount Whitney, California, at Bassour, Algeria, at Mount Harqua Hala, Arizona and Mount Montezuma in the nitrate desert of Chile. He developed instruments capable of measuring a millionth of a degree change in temperature and other instruments of the greatest complexity and usefulness to be used in connection with his measuring instruments for standardizing and for computing results.

The outcome of all this work was to justify his belief in the truth of his theory. But some of the most prominent weather men in the world disagreed with Dr. Abbot. They did not doubt that weather would change if the sun's heat varied, but they were not convinced by Dr. Abbot's work that the sun's heat does vary.

They based their criticism on the difficulty of measuring the sun's heat accurately through the atmosphere which intervenes between the earth and the sun. This atmosphere is so variable in transparency and in its content of water vapor and dust that these scientists feared Dr. Abbot was misled. They believed that the variations he found were due to atmospheric and not to solar changes.

The proof which Dr. Abbot now announces appears to finally refute these criticisms and to leave no further doubt of the variability of solar radiation.

The essence of this proof lies in a comparison of measurements of solar radiation made at times when the atmosphere is practically identically the same. It is obvious that if the atmosphere is the same and the instruments are correct any changes must mean differences in the amount of heat given off by the sun.



Visual proof that the intensity of the heat radiated by the sun varies. The dotted line shows the changes for Julys 1910-20, according to the solar constant values already published by the Smithsonian Institution. The black line shows the variation newly determined from measurements made on days when atmospheric conditions were identical. Double line shows variation of sunspot numbers. The similarity of the lines establishes the claims of Dr. Abbot

Dr. Abbot selected measurements made in the month of July for the years 1910 to 1920, omitting the years 1912 and 1913 because the volcano of Mount Katmai in Alaska filled the atmosphere of the whole northern hemisphere with dust in those years. During all these years Dr. Abbot and his assistant, Mr. L. B. Aldrich, had measured the sun from the same observatory on Mount Wilson, California. They used the same instruments throughout and these instruments were regularly tested against standards and found unchanged.

From the measurements made in these months he selected the days when the atmospheric transparency and its content of water vapor were practically the same, dividing these into comparable groups. All days in any year in which atmospheric conditions were not practically identical to those in other years he discarded.

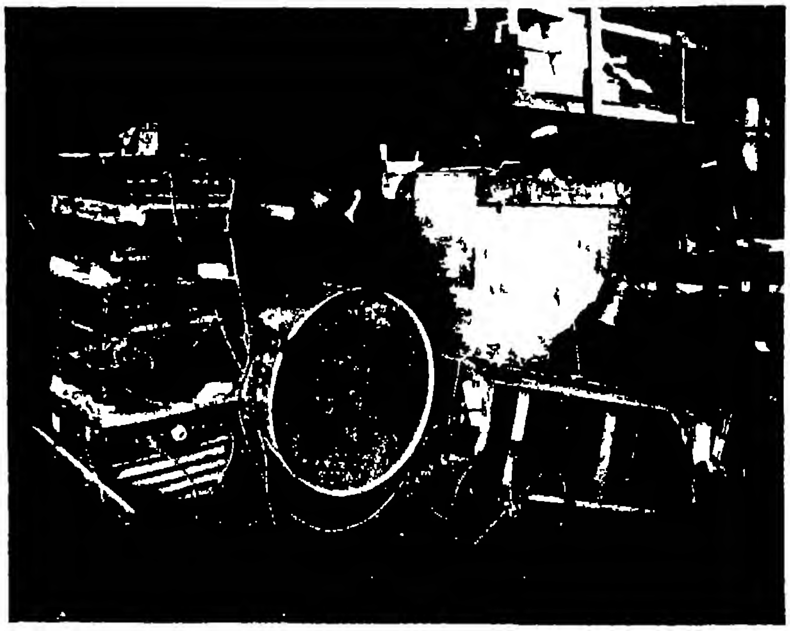
He then plotted the measurements of the total quantity of heat received at the earth's surface. On the same paper he plotted the solar constant values for these years as previously published. (These solar constant values are the result of the measurements of the total quantity of heat received at the earth's surface, corrected by measurements of the loss of heat through the earth's atmosphere so as to indicate what would be found outside it—on the moon, for instance.) How closely the two results parallel one another is shown by the accompanying chart.

As a further proof of the accuracy of his measurements of the variability of solar radiation Dr. Abbot plotted the average number of sun spots for Julys of the same years on the same paper. The harmony is again apparent.

Such is a simplified account of the proof that the radiation from the sun varies over a long period of time closely in harmony with the sun's visible evidences of activity. But Dr. Abbot did not stop here. He used a slight modification of the same method to show that short interval changes within the individual months are also verified by this simple process. It seems as if these demonstrations should convince meteorologists that the time is ripe to test the effect of solar changes on the weather.

With this great step accomplished the next move is to make the daily measurements of solar radiation as accurate as is humanly possible. To help accomplish this the National Geographic Society has given $55,000 to establish a solar observatory at Mount Brukkaros in Southwest Africa to cooperate with Dr. Abbot's two existing stations in California and Chile. To insure that at least one accurate measurement will be made for every day in the year a fourth station is needed in the northern section of the Eastern Hemisphere.

* * *



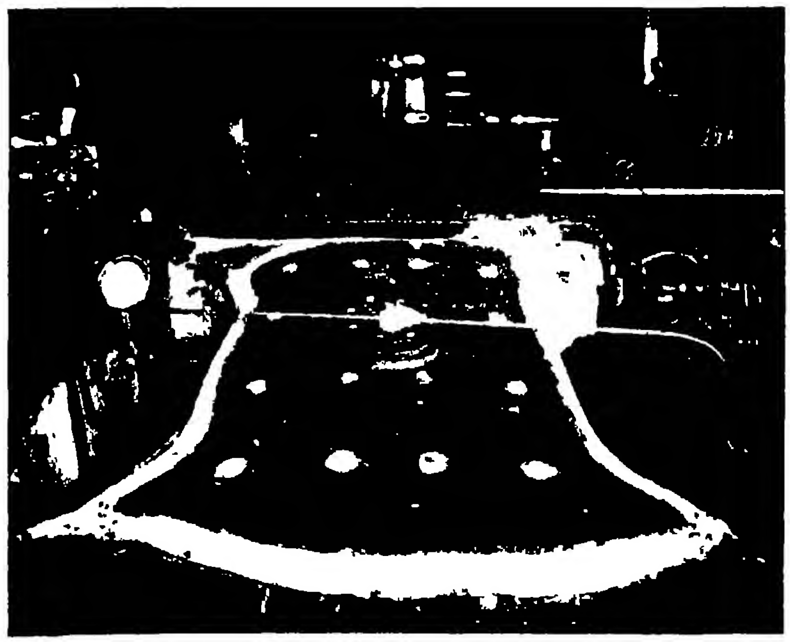
The compact, portable welding equipment with which the repair job shown below was performed

An Interesting Cylinder Repair

RECENTLY in a plant at Little Ferry, New Jersey, the low pressure cylinder of a 900 horsepower engine was subject to an accident in which the entire top of the cylinder was blown off.

It appears that by some unknown means, the full boiler pressure was put on the low pressure cylinder with the result that the cast iron top, one and one half inches thick, was blown into several fragments and entirely ruined. Fortunately no one was seriously hurt although five men were in the engine room at the time. To get a new cylinder would have taken months.

Considerable interest attaches to the repair work on this job both because of the short time taken to do it and because of some of the details of the weld. Fortunately the head official of the inspection department of the insurance company which carried the risk on the broken engine, had had considerable experience with arc welding. He therefore had the courage to make this repair by that process. His faith in cast iron welding had been built on the use on several jobs of transformer welders with alternating current, so he turned to this type of apparatus, renting two welders together with their operators.



How a large, broken cylinder-head was repaired by electric welding

The top of the cylinder was completely welded between Friday morning, March 26 and Sunday afternoon March 28 and the engine was put back in operation on Monday morning at 7 00 A M Our photograph shows the entire patch which measured 42 x 62 inches and had an irregular contour

A group of telescope enthusiasts gathered in a semi-circle around one of the new, Springfield mountings (which is nearly obscured in the picture), listening to a demonstration Just over the mountain ridge in the dim background stands the old Coolidge homestead. All the neighboring mountains are thickly forested

A special steel casting had to be made from a pattern which was first fitted over the break itself This casting was larger than the break and the outer edge of the break was chipped so as to form the necessary bevel to weld clear through This casting was stay bolted securely by means of one eighth inch rods welded into its top surface with the proper bevel The cast iron break was studded with steel all the way around The cracks which extended from the break were also studded All was now welded by the alternate process The entire job was caulked in order to relieve the strains

When the pressure test was applied several leaks were located in the cast iron These were stopped by caulking as were two leaks in the patch casting itself These leaks were probably due to the speed with which this casting has been made They were cut out and rewelded The engine is now in service just as it was before the accident after considerable saving in time and money not to mention the saving of the loss to the community which would have otherwise resulted by shutting down the plant for any considerable length of time

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Telescopes

When the present writer to follow his inclinations he would be likely to fill the entire space allotted to the Digest with matters pertaining to amateur telescope making. The campaign for the popularization of this interesting work has brought better results than we anticipated More than twelve hundred would-be telescope makers have been traced since we began this campaign with the publication of Mr Porter's two articles last February and March and followed with the publication of the book, Amateur Telescope Making

No effort has yet been made to organize the telescope makers nationally although local groups have been formed in a few cities The Rocky Mountain Amateur Telescope Makers Club has been organized in Denver it having originally been discovered there that several heads were better than one and that a man who is an expert machinist but not a scientist could help another man who is a scientist but not an expert machinist, the two turning out an excellent telescope which neither could turn out so well alone

In the city of Los Angeles alone more than 50 beginners have been traced Possibly a club will be organized there if a telescope maker having a penchant for organization can be found to do the work Everywhere the spirit of the amateur telescope maker is excellent and it generally turns out that when two of them meet all differences dissolve in favor of the common bond of interest

Here it might not be badly out of place to state that it is altogether proper to address the telescope enthusiast as a T N this having been the custom for many years among those few who have previously followed this work T N stands for telescope nut and is the fraternal or brotherly loving form of address between true enthusiasts For the benefit of those who have not yet been inoculated with the germ of the telescope making disease it should be said that once the inoculation has taken the spell lasts for many years. A man sets out thinking he will make a single telescope for the purpose of learning the elements of astronomy He is apt to find however that this telescope is only his first and that he has found a hobby that will pursue him all his life Indeed the writer corresponds with one T N who at 78 after having suffered a stroke of paralysis which incapacitated one arm, is now building a machine for making a mirror

Our mail shows that most of the amateurs have made out well in their efforts Perplexities have arisen of course but work which involved no troubles would have little inherent interest One is especially impressed by the existence in this country of large numbers of people who while engaged in all kinds of occupations besides the mechanical are nevertheless expert mechanics Already in July the photographs of most creditably built instruments, with their descriptions are beginning to reach us Two that we hope to describe next month are especially trim and workmanlike. When winter comes, and athletics, golf, fishing and other summer sports are laid aside, it is likely that many more will begin building their telescopes than have done so already

One most interesting aspect of the new movement was the gathering of a group of invited T Ns at *Stellafane* Springfield Vermont, over the week-end of the Fourth of July Invitations were sent out by the "Telescope Makers of Springfield" (which by the way is an amateur not a business organization) and nearly 30 enthusiasts from several states made the trip to Vermont in order to convene rub elbows and talk telescope making with their confreres One T N who could not be present writes as follows "Oh it must be so delightful to get away from all these safe sane and conservative people for a little while and get with a bunch of cranks all as crazy as one's self Then to see a lot of telescopes and talk with their makers what could be more heavenly? I am glad the skies favored you with a smile"

Mutual introductions having been exchanged the amateur visitors at Springfield were first initiated into the mysteries of silvering mirrors This is an art which has long been regarded as secret If such has ever been the case the secret is now out for Russell W Porter leading spirit of the "Telescope Makers of Springfield" demonstrated before the visitors that it could be done in about half an hour providing the conditions were right The mirror is silvered in an enamelled pan about two inches greater in diameter than the disk itself It must be handled with rubber gloves as the least trace of saltiness from the skin or of oil results in failure The pan is kept in motion during the process which is complete when black blobs appear The silver coating is usually deposited in less than five minutes However even old hands at silvering frequently fall down on this job so the amateur who fails to obtain a fine coating at first need not be at all discouraged Persistence and care will soon result in the desired perfect surface

The visiting amateurs next inspected an apparatus for performing the knife edge test by means of an electrically illuminated device invented by Mr J Watson Thompson an attorney of Cambridge Maryland Ordinarily this test has been performed with the aid of an oil lamp which however has many objectionable qualities one of which is the blistering of the face of the amateur who must place his eye near it. When an attempt is made to substitute an ordinary electric lamp for the oil lamp the pinhole in the metal chimney acts in the same way as the "lens" of an old fashioned pinhole camera It throws a bright inverted image of the filament in the mirror illuminating it unevenly But after frosting the exterior of a 115 volt candelabrum lamp by rubbing it with a curved strip of thin metal with some medium sized carborundum between the two Mr Thompson succeeded in diffusing the light emitted by the pinhole so that the electric lamp serves as well as an oil lamp The cylindrical bulb is lowered upside down into a metal cylinder having the regular pinhole but it is well to insert some resistance in series with the lamp since the confinement of the latter within the tube results otherwise in overheating its filament and a burn-out soon follows, necessitating the preparation of a new bulb

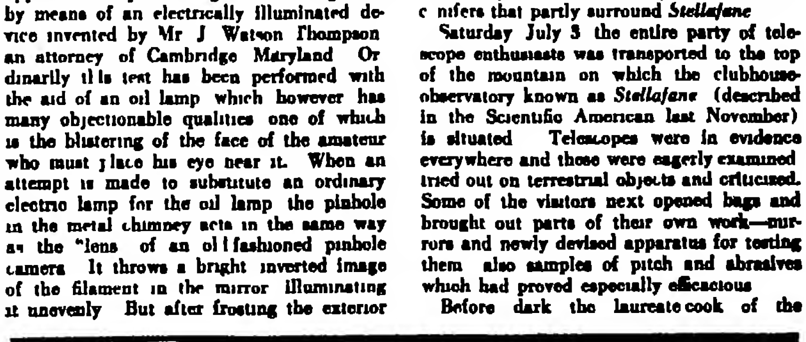
Porter's Springfield Mounting, on a permanent base in front of *Stellafane* Facing the camera, is Wilbur Perry who became a genius at mirror making while still a youth

Among the visitors at Springfield were three groups from various laboratories of the General Electric Company These men were interested in telescope making on their own account One man from the research department of the Navy came from Norfolk Virginia A number of interested young men camped out in a tent pitched near the conifers that partly surround *Stellafane*

Saturday July 3 the entire party of telescope enthusiasts was transported to the top of the mountain on which the clubhouse-observatory known as *Stellafane* (described in the Scientific American last November) is situated Telescopes were in evidence everywhere and those were eagerly examined tried out on terrestrial objects and criticized. Some of the visitors next opened bags and brought out parts of their own work—mirrors and newly devised apparatus for testing them also samples of pitch and abrasives which had proved especially efficacious

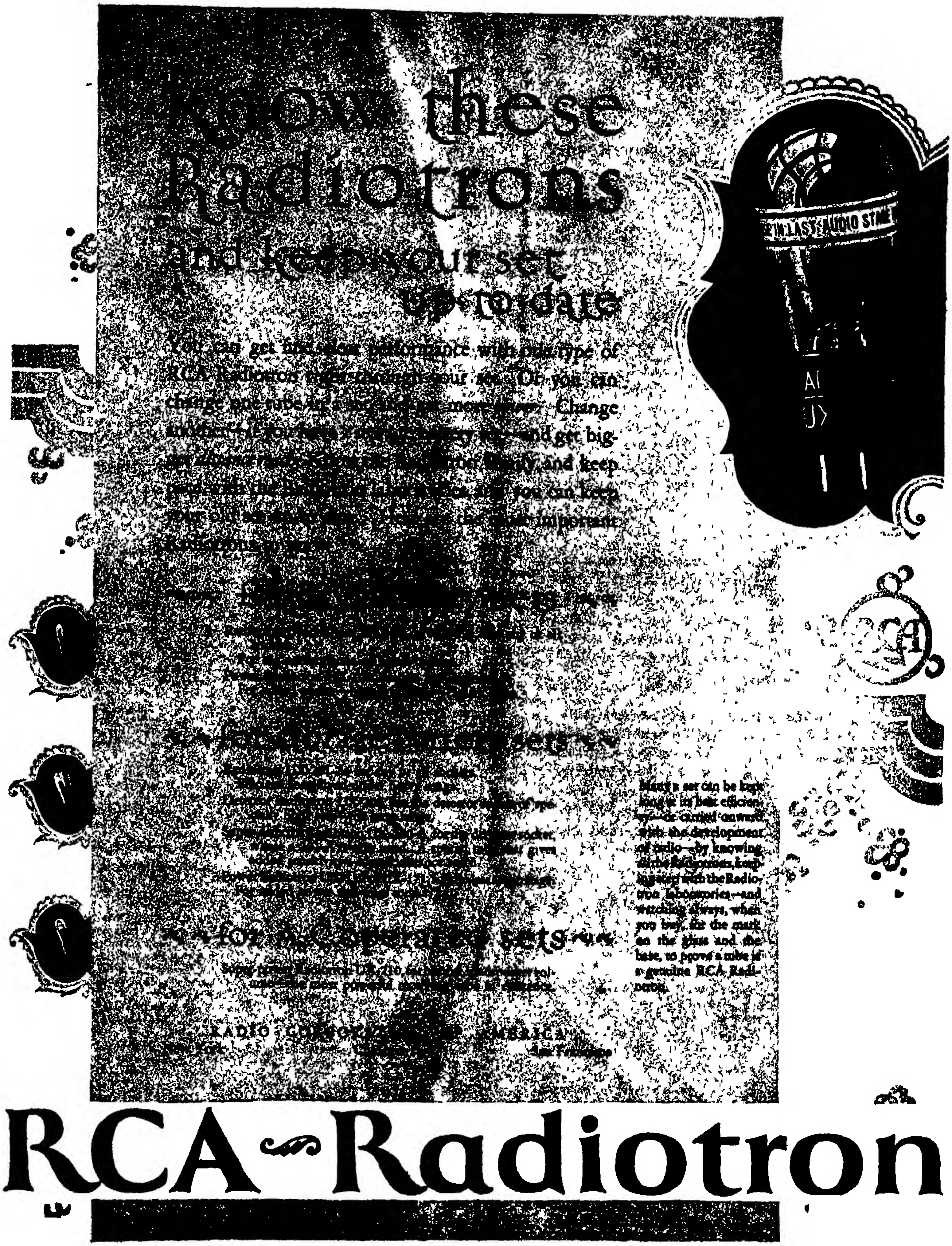
Before dark the laureate cook of the "Telescope Makers of Springfield" announced supper What a supper it was! Mr Redfield, who unwillingly consented to be hauled out of doors and posed for the picture shown on these pages, is king of the

(Continued on page 214)



Amateur astronomers gathered in little knots on the stone platform in front of *Stellafane*, "talking it over" Three telescopes show in the photograph

The postcard invitation which was sent out


these
Radiotrons
up-to-date
IN LAST AUDIO STAGE
RCA-Radiotron

kitchen at *Stellafane.* He, like the rest, has made his telescope. He also makes johnny cake and enjoys cooking for the rest of the members. On this occasion he fed 29 and fed them to utter completion. This number was greater than he had ever fed before at *Stellafane.* "But," he remarked, whimsically, "when I get a little older I will probably do better."

Supper over, the amateurs were confronted by the night, for plans had been laid to stay up, like the traditional astronomer, until daybreak. The stars came out in myriads. Even the Milky Way, which the writer, living in a suburb of New York, has not even glimpsed in three years, owing to the haze and glare of the metropolis, showed brilliantly from the top of this Vermont mountain. Half, perhaps, of the visitors spent the night at the various telescopes that were scattered about outside of *Stellafane.* The other half remained indoors around a long table, arguing about this and that, and the theory of relativity and the "whichness of the why."

Saturn's rings were, of course, the show piece of the early evening. Later in the night came Jupiter, with three satellites easily visible and one in transit across the face of his disk. Then came Mars, ruddy but poorly visible due to temporary atmospheric conditions. The moon followed as dawn approached, and finally Venus, brilliant, white, dazzling, rose over the mountain ridge in the east.

Mr. Redfield, laureate-cook of the "Telescope Makers of Springfield," author of the verses at the right, and senior member of the club

Inside the *Fane,* as the early hours of the morning approached, some of the visitors could be seen stretched out on cots, snatching catnaps between the frequent outbursts of a group of mathematical "sharks" who, it appeared, had raked over the whole science of mathematics in search of unusual problems about which to wrangle. They had forgotten astronomy, telescope making, everything, while they proved by several methods that two equals one, or discussed some equally abstruse matter. About every five minutes the sleepers were rudely awakened by the resonant voice of one man whose best form of argument was blunt contradiction.

The following day, the Fourth of July, was given over to further discussion. John Pierce, one of the leading lights of the Springfield group, gave a talk on the making of small lenses while the visitors sat in the shade of a row of deep green spruce trees which formed the edge of the primeval forest that covers the top of the mountain. Then Mr. E. H. Redfield, the laureate-cook, all decked out like a professional chef, stood on a tree stump and recited his famous verses about an eventful trip taken by the "Telescope Makers of Springfield."

The Telescope Maker's Dream

I dreamed that the Springfield Telescope club
Took a trip to the planet Mars,
And established ourselves on a mountain top
From which to view the stars.

That we carried a monster telescope,
A 'scope of most wonderful power,
And watched the stars and worlds roll by,
For many a countless hour.

And the sights we saw in realms beyond,
The vision of this world's eyes,
Were a ceaseless wonder and endless source
Of pleasure and surprise.

When the people of Mars inquired who we were,
And where was the land of our birth,
We turned that telescope around,
'Til it pointed to the earth.

And told them to look and see for themselves,
The land from whence we came,
And if all went well we hoped to return
To our native land again.

And when they had looked to their hearts content,
And examined the whole world o'er,
They said such a wonderful telescope
They had never seen before.

They saw great cities and towns on the land,
And ships that sail on the sea,
And questioned us closely of all that they saw,
And wondered that such things could be.

Then a wise old professor said, "Tell me I pray,
"What are those black bugs that I see
"That run round so lively and in such great droves?
"They're a new kind of insect to me."

"Please tell me their name and habits of life,
"For we have no such insects on Mars."
Mr. Fullam spoke up and said: "My dear sir,
"Those insects are Henry Ford cars."

We dwelt with those people a year and a day,
And found them a people of worth;
But then we were homesick and thought it was time
That we should return to the earth.

Of our journey to earth I have nothing to tell,
I felt a hard bump on my head—
I suddenly 'woke—'twas the end of my dream—
And found I had rolled out of bed!

On the same afternoon the amateurs, tired and sleepy, but filled with many impressions about telescopes, optics, mirrors, prisms and no end of other similar things, made a tour about the village of Springfield, inspecting five telescopes which were mounted in the dooryards of their owners, instead of on the mountaintop at *Stellafane.* Some of these have been described in the Scientific American and others will be described in future issues.

Through one, that of Oscar Marshall, the star Sirius was shown to the visitors in the blaze of the afternoon sun. While there is nothing remarkable about this feat, it nearly always impresses the tyro quite visibly.

After three years of this work the fun of making telescopes has not abated in Springfield. One gets the impression that the little Vermont community fairly bristles with telescopes made by the amateurs. It is expected that before long the entire United States will bristle similarly. And next summer, it is hoped, a larger number of amateurs will visit the TNs' "get-together" at *Stellafane,* establishing the affair as an annual pilgrimage to the shrine where the recrudescence of this interesting work took place.

(Continued on page 216)

Wharf barge built entirely of steel and iron The cabin is made of armco iron, which, being almost free from sulphur, is rust-resisting

Floating Wharfs as Barges

WILL the picturesque wooden barges that ply along our many inland waterways be replaced by metal substitutes? Will the oldtime barge captain command a floating wharf? Such a barge with all metal structure has appeared on the Mississippi River in Louisiana It is virtually a floating iron house with iron roof sides downspouts and gutters Barges with metal hulls are common but metal superstructures are not such familiar sights This unique craft has a cabin of large capacity and apparently great weight But it is not as heavy as it appears though more than 20 000 pounds of iron were used in the superstructure alone The sheets are of light 24 and 26 gage material and are designed to stand hard knocks because of the corrugation for such sheets have proved to be very strong and durable

What of the old bugaboo rust? Such a large surface would ordinarily be a fine field for it Salt air water and coal smoke would as a rule cause much corrosion. The cabin itself measures 200 feet long by 32 feet wide while the hull is some 30 feet longer and eight feet wider with a depth of 12 feet The work of frequently painting such a boat would be very expensive if this was the only preservative used But this barge cabin is built of a special analysis iron with rust resisting qualities. While the first cost of such material is slightly higher its additional life is counted on to justify its use This iron is also galvanized and it can be painted for further protection if so desired The large sliding doors are very easy to open or close and greatly facilitate the handling of freight

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Smithsonian Anthropologist Finds True American Type in Central Asia

IN far away Tibet 6 000 miles distant from the nearest point of the American continent there exist true American Indian types This conclusion which throws such important light on the question of the origin of the American Indian is one of the profoundly significant fruits of a remarkable journey of 50 000 miles covering half the globe and occupying seven months which Dr Ales Hrdlicka made under the joint auspices of the Smithsonian Institution and the Buffalo Society of Natural Sciences in 1925 and the first account of which now appears in the Annual Exploration Pamphlet of the Smithsonian Institution

Dr Hrdlicka who is curator of Physical Anthropology in the United States National Museum and who recently published a description of the new type of white American, undertook his journey to survey what has been and what is being done in the study of ancient man and of the fossil apes in France, India, Ceylon, Java, Australia and South Africa Such a world survey of the position of physical anthropology is perhaps unique, and it produced results of great significance

Of the types found in Tibet (and elsewhere in Eastern Asia) Dr Hrdlicka says that they are so true to that of the American Indian that if they were transplanted into America nobody could possibly take them for anything but Indian. Men women and children resemble the American aborigines in behavior in dress and even in the intonations of their language The importance of the light his discovery throws on the origin of the native Americans is obvious.

After a brief stop in France Dr Hrdlicka early in April last year took ship to India, stopping to examine some Arab types at Port Said and Aden Of the pure-blood Arab the anthropologist says that he shows a lively intelligent white man's physiognomy (thought mostly brown in color) and that the higher class pure Arab is often as light as the Southern European

At present one of the most interesting problems in anthropology is to explain the presence of the Negrito in the Philippines and Andamans How did he get to his present homes? His nearest relatives are apparently the Pygmies of Central Africa, but a great unbridged space has until now separated the two If he extended from Africa he must have left traces of his passing in Arabia and India Such traces so far at least as the Indian coast lands are concerned Dr Hrdlicka became satisfied do exist They occur in Parganas northwest of Calcutta in at least one area along the eastern coast here and there among the Dravidians, and in the Malabar Hills These discoveries bring the Negrito a long way farther to the westward and so much nearer Africa making his derivation from that continent so much the more probable

With regard to the bulk of the present population of India Dr Hrdlicka believes he can say with confidence that it is mainly composed of three ethnic elements—the Semitic the Mediterranean and in certain parts the Hamitic or North African. The "Aryans" show everywhere either the Semitic or the Mediterranean type. Dr Hrdlicka saw nothing that could be referred to the types of Central or Northern Europe It would seem therefore that the Aryans came from Persia and Asia Minor rather than from or through what is now European Russia

Passing through Ceylon where he reports no definite trace as yet of geologically ancient man Dr Hrdlicka proceeded to Java touching at Sumatra and the Straits Settlements. Of Sumatra, a country not yet perfectly known, he says that "there still prevail in the island, among the whites as

(Continued on page 218)

well as the natives beliefs in the existence of wild men There are said to be two varieties The Orang Pandak (orang—man, pandak short) is said to live in the almost impenetrable mountain forests of the central and southern parts of the island The natives describe him as black short long haired, and wild but not insurmountably shy The second form is the Orang Sedapak He is said to live in the unhealthy lowlands of the southeastern part of Sumatra He is described as having the body of a child of 12 with long red hair on head and body He is very shy and runs but does not climb"

In the mountainous regions of the upper parts of the Malay Peninsula according to information given to Dr Hrdlicka there still live thousands of negritoid people and there are many old caves waiting to be explored

The data obtained in Australia writes Dr Hrdlicka throw a very interesting and to some extent new light on the moot question of both the Australian and Tasmanian aborigines. According to these observations, the Australian aborigines deserve truly to be classed as one of the more fundamental and older races of mankind and yet it is a race which shows close connections with our own ancestral stock—not with the negroes or Melanesians (except through admixture) but with the old white people of post glacial times

As to the Tasmanians the indications are that they were but a branch of the Australians modified perhaps a little in their own country Both peoples have lived and the Australians of the northwest live largely to this day in a paleolithic stage of stone culture They are still making unpolished stone tools which in instances resemble the Mousterian implements or later European paleolithic types But they are also capable of a much higher class of work Today about Derby bottles are used in making beautifully worked spear heads

From Australia Dr Hrdlicka's journey led to South Africa and disembarking at Durban Natal the first task was to see as many as possible of the Zulu about whose exact blood affinities there was some doubt From an examination of many individuals the anthropologist reached the conclusion that the Zulu is unquestionably a true negro though now and then as in other negro tribes showing a trace of Semitic (Arab) type due probably to old admixtures

The two main objects of the visit to South Africa were the investigation on the spot of the important find of the Rhodesian skull and of the recent discovery of the skull of a fossil anthropoid ape at Taungs which had been reported as being possibly a direct link in the line of man's ascent The Rhodesian skull found in 1921 at Broken Hill shows a man so primitive in many of its features that nothing like it has been seen before Dr Hrdlicka was able to clear up some of the moot points in connection with this important find and he collected for study bones of animals from the cave which gave the Rhodesian skull as well as two additional mineralized human bones belonging to two individuals all of which were deposited with the earlier relics in the British Museum

The fossil skull of an anthropoid ape found at Taungs in 1924 belongs according to Dr Hrdlicka, to a species of anthropoid ape of about the size of a chimpanzee and evidently related to this form though there are certain differences especially in the brain These differences suggested that this ape may possibly have been somewhat superior to the chimpanzee and nearer to the human But it is not necessarily a form that stood in the direct line of the human phylum

South Africa is a land rich in material for the anthropologist according to Dr Hrdlicka "There is he writes the disappearing old native population of Bushmen Strandloopers, and Hottentots, the newer negro population which amounts already to over 7 000 000 and is steadily increasing, the almost stationary population of 1,500,000 South African whites of Dutch and English derivation, who are blending together and producing a type of their own (as is also happening on a larger scale with the whites in Australia); and there are abundant remains of paleolithic cultures."

Dr Hrdlicka has returned from his fruitful journey deeply impressed with the opportunities and need for anthropological research offered by all these distant parts of the world, and the openings everywhere for American cooperation "The story of man's origin differentiation, spread and struggle for survival,' he says 'is evidently greater far greater, than ordinarily conceived, and a vast amount of work remains for its satisfactory solution"

* * *

Why America Is Prosperous

CONSIDERABLE notice has been attracted in Great Britain by a report which was recently rendered to British industrialists by two Englishmen Bertram Austin and Francis Lloyd These gentlemen have been traveling extensively in the United States with a view to trying to determine the fundamental causes of the great prosperity of American industry and whether or not American industries are employing methods which England might profit by studying "The Secret of High Wages is the title of the book which they have written

The findings of these two students of industry are as follows

1 Promotion in America is by merit
2 America sticks to the principle of small profits and quick returns and wealth is made by fine margins of profit on immense and rapid turnover
3 Rapid turnover is secured by simplification and cheapening of processes which necessitates less capital for a given output
4 America shows endless keenness in devising time saving and trouble saving appliances
5 The American employer is not hostile to high wages
6 American manufacturers cooperate by exchanging ideas
7 Americans are vigilant and acute in eliminating waste and in conserving time energy and space
8 American welfare methods double high wages in their stimulative effect by surrounding the workers with cleanliness and light and by seeking in every way to increase their convenience and satisfaction
9 Americans encourage research with magnificent intelligence scouring the world to obtain the best research brains

If Britain could teach us her unequalled respect for the law in exchange for the industrial lessons she is learning from us both nations would profit

* * *

Why Clean Rifle Bores? Seal Them.

FIREARMS enthusiasts as well as those who served in the infantry during the World War, will take interest in a new bore-seal invented by Col John F McGill of the United States Marine Corps for the purpose of hermetically sealing the bores of the United States rifle commonly called the 'Springfield' rifle

The most sensitive and vulnerable part of our present rifle insofar as accuracy is concerned is the muzzle end of the lands and grooves says Col McGill in a report rendered to the War Department For years riflemen have been cognizant of this fact and have tried by one means or another to protect these parts To preserve them however, requires more care and experience than is usually found among those armed with this weapon and too often the piece is ruined because of improper cleaning or a failure promptly to remove fouling of a corrosive nature from these parts.

In order to seal the barrel many have used a stopper which was forced into the muzzle This was ruinous because of the moisture and dirt carried into the end of the barrel by the stopper and the resultant pitting and corrosion This practice is now prohibited.

The whip and friction of a metal cleaning rod when used from the muzzle end will

(Continued on page 220)

quickly destroy the accuracy of the rifle This practice is also prohibited These two points are mentioned to show the importance of maintaining the ends of the lands and grooves of the bore intact The device described below seals the muzzle without coming in contact with the bore, and its use does not necessitate a change in the design of the rifle.

After extensive tests by the Bureau of Mines in 1922 it was found that the principal agent causing the corrosion in rifle barrels after firing was potassium chloride which is a residue left in the barrel from the primer As this potassium chloride is the active agent of corrosion it is necessary that it be entirely removed from the barrel to prevent the rusting and pitting which is the cause of condemning many rifles

Potassium chloride is a substance that is absolutely insoluble in oil or grease of any kind but is readily soluble in water Small particles of this chemical lodge in the minute fissures and the tool wounds in the barrel of the rifle and while a thorough cleaning of the barrel with a cloth saturated in oil will mechanically remove the residue on the surface so that the barrel will appear to be perfectly clean the particles of the potassium chloride lodged in the manner described remain to corrode and injure the barrel as they cannot be removed by the cloth and the oil cannot dissolve them

It is claimed that if the device shown in the accompanying illustrations is promptly placed on the muzzle after firing care being taken to allow the empty cartridge to remain in the chamber corrosion from the residue of our present rifle powder or from atmospheric conditions cannot occur The same would apply to rifles in store which had never been fired—corrosion in the bore from the combined action of heat and cold and the various stages of humidity would not be possible

In other words the use of the seal would protect the bore more effectually than the most careful cleaning In fact a certain amount of injury is sure to occur as a result of cleaning no matter what care may be exercised so that a rifle the bore of which had never been cleaned, would be in better condition provided the seal was properly used than one firing a like number of rounds, notwithstanding that it may have received the most careful attention This, of course, has no reference to the metal, or so-called "copper" fouling, which at the present time causes, comparatively speaking, little trouble

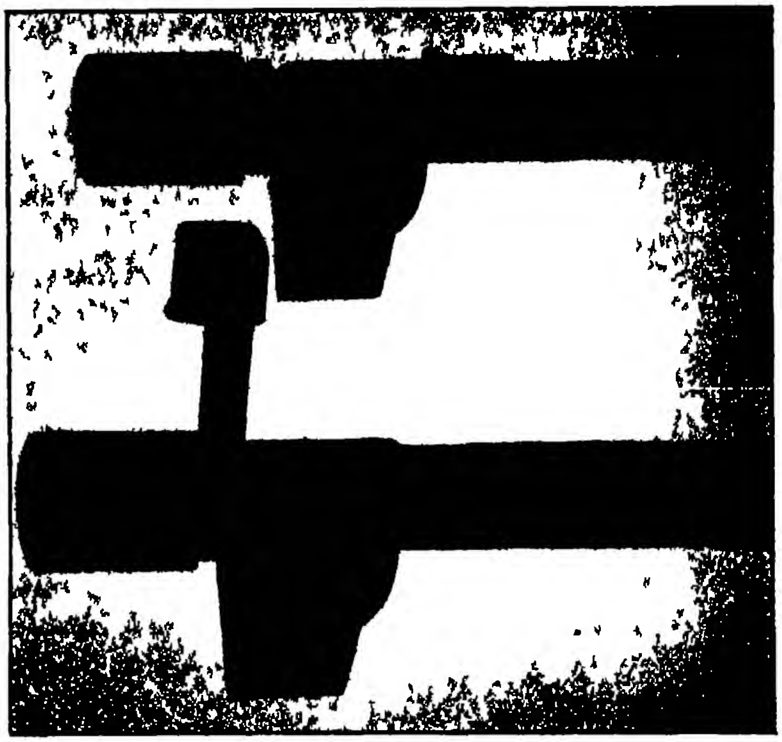
Serious injury to rifle barrels is not infrequent in the tropics because of the deposit of foreign material in the bore by insects. The wasp and ant are the most persistent offenders in this regard Rifles exposed in racks or in store, are frequently filled at the muzzle with mud which seems to be particularly injurious in a very short period of time This deposit is apparently highly corrosive.

Rifles carried in the rain, those exposed in open boats rifles in racks and in store aboard ship and those taken ashore by landing parties (where there is no opposition) are subjected in the absence of a sealed bore to conditions that can cause serious injury due to corrosion from moisture

During the World War the destructive effect of phosgene chlorine and other gases on the metal parts of the rifles was very marked It is true that in the majority of cases where rifles were thus exposed they were being fired or held in readiness to fire and the use of the seal would not have been practicable Nevertheless, much injury was done to rifles not in use and which could have been saved by the use of a seal.

The present bolt of the rifle when closed with firing pin up or down will not prevent a certain amount of air from entering the breech. It is therefore best to seal or close the space left between the bolt head and the barrel This can be accomplished conveniently and economically by closing the bolt on an empty cartridge case

The subject of corrosion under oil films, with special reference to the cause and prevention of the after-corrosion of firearms, is thoroughly treated in Technical Paper 188 of the United States Bureau of Mines. This may be had only of the Superintendent of Documents, Government Printing Office, Washington D C, for five cents (government agencies do not accept postage stamps)



Above: Colonel McGill's rifle bore seal for the prevention of corrosion, in place of the muzzle of the army rifle. It locks behind the ringlike front sight stud. *Below:* The bore seal may be removed without tools

* * *

Fastest Revolving Wheel

What is said to be the fastest revolving wheel in the world is an important part of the special equipment used by Lieut. John MacReady in his recent attempts to better the world's altitude record This is the turbine wheel on the supercharger of his airplane. It revolves at a speed almost inconceivable to the human mind, turning 40,000 times a minute, almost 700 times a second.

When it is realized that this speed must be maintained sometimes in a temperature of 11 degrees below zero the perfection necessary in the mechanism will readily be apparent.

A slight idea of just how fast this is may be gained by comparing it with the speed limit of the average automobile crankshaft At the highest speed the crankshaft reaches about 2,000 revolutions per minute or only one-twentieth of the speed of this supercharger turbine wheel.

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Effect of Sea Water on Cannons Sunk for Centuries

Few of us would believe on first thought that cannon balls sunk in the sea for nearly 300 years would become red hot on exposure to the air and then fall to pieces like so much dried mud Yet the fact is well attested in documents of the British Navy The data presented below were furnished by Mr John S Carpenter and were originally obtained from the 1882 edition of Trautwine's "Civil Engineer's Handbook

The *Mary Rose* which in her day was as proud a vessel as any that sailed the British waters, and which is said to have taken part in the battle with the Spanish Armada was raised after having lain in Davy Jones locker for 296 years. When she sank she was armed with brass cannon and some that were built of wrought iron bars hooped together The brass cannon were badly honeycombed in spots, that is locally and not on the entire surface It was thought that the local corrosion was due to iron having been in contact with the brass at those places The wrought iron cannon were rusted down about 30 inch deep all over and flaked off very readily The cast iron shot or cannon balls when raised to the surface where the air had access to them gradually became red hot and then fell in many small pieces like dried mud

The *Edgar* a vessel of a later period gave up some of her cannon and other metal parts after having been sunk for 134 years as did the *Royal George* after some 65 years General Pasley who made the official examinations of the metals recovered reported that in the great majority of cases the cast iron had become quite soft and that it greatly resembled plumbago Some of the shot when exposed to the air became very hot and exploded into many pieces

The wrought iron in this case was not so much injured except when in contact with copper or brass gun metal showing that electrolysis was at work at these places Neither the copper nor the gun metal was injured except when iron had been in contact with them A few pieces of wrought iron were reworked by a blacksmith who declared that its quality was better than that of modern wrought iron Some of the cast iron guns were removed in their soft state to the Tower of London where after some four years they resumed their probable original hardness.

In the case of a vessel that had been sunk in the fresh waters of the Delaware River for over 40 years the cast iron cannon raised were found perfectly free from rust

Unprotected parts of cast iron sluice gates, parts of the sea gates of the Old Caledonian Canal in Scotland were converted into a soft plumbaginous substance to a depth of three-quarter inch, but where the cast iron parts were coated with tar or pitch, they were entirely uninjured This softening effect also takes place where the cast iron was embedded in salty earth Some cast iron water pipes laid near the Liverpool docks, were soft enough to be cut with a knife after 20 years, while the same material of the same pipeline laid on higher ground away from the salt water were as good as new after 50 years.

Observation has shown that the rapidity of this softening action depends much on the quality of the metal, the darker colored types of iron which are high in mechanically combined carbon suffering most, while the lighter colored grades last much longer

Radio Notes

A Review and Commentary on the Progress in This Branch of Rapid Communication

Conducted by Orrin E. Dunlap, Jr.

Herbert Photos

The highly polished ball that the young man is holding in the above illustration is the latest in radio aerials. The lead in wire is connected to the surface of the ball, which may be mounted on a pole on the housetop

Doubt If Radio Makes Rain

PAUL PAINLEVE French Minister of War recently made a statement that he believed radio waves responsible for the rains and chilly atmosphere that persisted during April May and June He called attention to the fact that the introduction of Hertzian waves into a tightly closed room where the air is absolutely transparent causes little drops of water to form on the faces of those present in the room He explained that the Hertzian fog found in every home had become ionized and electrified, thus forming rain

When asked for his opinion on this subject James H Starr chief of the New York Weather Bureau said I am a skeptic Perhaps the people in France were complaining of the weather something had to be blamed so they picked on radio The more I study weather the more positive I become that we will never be able to control the weather '

When asked to comment upon the Painleve theory Hugo Gernsback said Nothing could be further from the truth The little amount of energy radiated by broadcasting stations is so infinitesimal that no known instrument can directly measure the amount of energy received three miles from the transmitter Only by amplifying the microscopic energy and by employing local A and B batteries are we enabled to make loudspeakers talk Heat in a room may cause perspiration but not radio waves

"Physicians and scientists who use Xrays which give off a gigantic amount of energy as compared to a broadcasting station find that even with the tremendous amount of ionizing power inherent in the Xrays no action on the atmosphere is ever noted

'The plain truth is that the cause of the unseasonable weather lies in the sun," said Mr Gernsback "The sun goes through an eleven year, sun spot cycle the minimum of which was in 1922 during which year radio reception was exceptionally good Since that time the sun spot cycle has increased and right now continuing up to 1928, when the sun-spot cycle is at its maximum, reception will be bad, and incidentally, probably the weather Radio reception will probably be at its best again in 1933"

Dr Alfred N Goldsmith, Chief Broadcast Engineer of the Radio Corporation of America, said that he did not agree with the Painleve theory and did not believe that radio had any effect upon weather conditions

There is probably as much truth as poetry in the words of the old song

Whether it's cold or whether it s hot,
We re gonna have weather whether or not
The weather we get and the weather we ve got,
We re gonna have weather whether or not.

Music Versus Photographs

WHEN the first radio pictures appeared someone remarked that they looked just like broadcast music sounded

Such a comparison is absurd" said W H Priess President of the Priess Radio Corporation The fact is that on a good receiver today the reproduction of the program is well nigh perfect The average ear could detect no difference between the studio program and the same program heard over the radio providing of course the set and the loudspeaker are of the best obtainable quality

'Aural radio reproduction is more natural to its original than a good photograph is to its subject There is simply no basis for comparing it with the accomplishments to date in transmitting pictures by radio The latter is about in the same state today where all radio was four years ago We learned to apply the correct electrical principle to the principles of acoustics, and today no one need apologize for radio reception, nor may anyone sneer honestly

"In the visual problems they have a start in the knowledge of lenses and camera principles just as we had in the knowledge of acoustics Through experiments they will learn how to apply the correct electrical methods, and the problems of the photoradio engineers will be solved Until then it is idle to compare the two"

No Radical Changes Expected by Dellinger

THE day of rapid changes in radio receiving sets has passed, and radio is now definitely established as a practical, dependable, permanent utility for every-day use,

according to Dr. J. H. Dellinger, Chief of the Radio Station of the Bureau of Standards.

"Following the period of experimental development, during which the market was flooded with scores of sets of all degrees of receptivity, the industry has now settled down to the production of a relatively few standard high-class sets, expertly designed and substantially built, which may be expected to give as good results five or ten years from now as they do when new," said Dr. Dellinger.

"There is no more reason for waiting to buy a good radio set than there is in waiting to buy a piano. While there doubtless will be occasional refinements in receiving equipment, these are not likely to affect the comparative values of the standard sets of today. Tubes, of course will lose their efficiency after from 1,000 to 2,000 hours of use, but most of them can be reactivated at small cost. The set as a whole, however, will retain its efficiency and value indefinitely."

National Network

SMALLER broadcasting stations in the United States will soon combine to form a chain for country wide broadcasting, according to Norman Baker, of Muscatine, Iowa, President of the American Broadcasters Association. A hundred or more stations, as the plan is outlined, will be linked together, but not by land wires. The plan is to have each station radiate its own program, and the advertiser using this style of advertising would be announced at the same hour from all stations in the organization. The broadcasts from each station will be entirely different. By this method, country wide advertising by means of radio will be promoted.

Two Tuning Units

A NEW A-C Dayton receiver, recently placed on the market, incorporates second stage tuning, which performs as though there were two sets in the cabinet. Where conditions require selective tuning, the first tuning stage is adjusted and then the second stage is brought into phase. This arrangement is said to compensate for differences in antennas, tubes, batteries, interference and other factors which may exist between actual operating conditions in the owner's hands and conditions which existed when the set was tested and balanced at the factory.

Neutrodyne for 1926-27

A NEW model neutrodyne set has been introduced by the Stromberg-Carlson Telephone Manufacturing Company. The general appearance and fundamental design is practically the same as the 1925 model. The changes are in the form of refinements which allow the use of either an outdoor antenna or loop; any semi power or power tube; any kind of current supply and any kind of power-output equipment. Binding posts are used for loop connections and a switch is provided so that the operator can quickly shift from loop to outdoor antenna. A power-switching relay inserted in the wiring of the "A" and "B" socket power, controls these units automatically as the battery switch on the front panel is turned on or off.

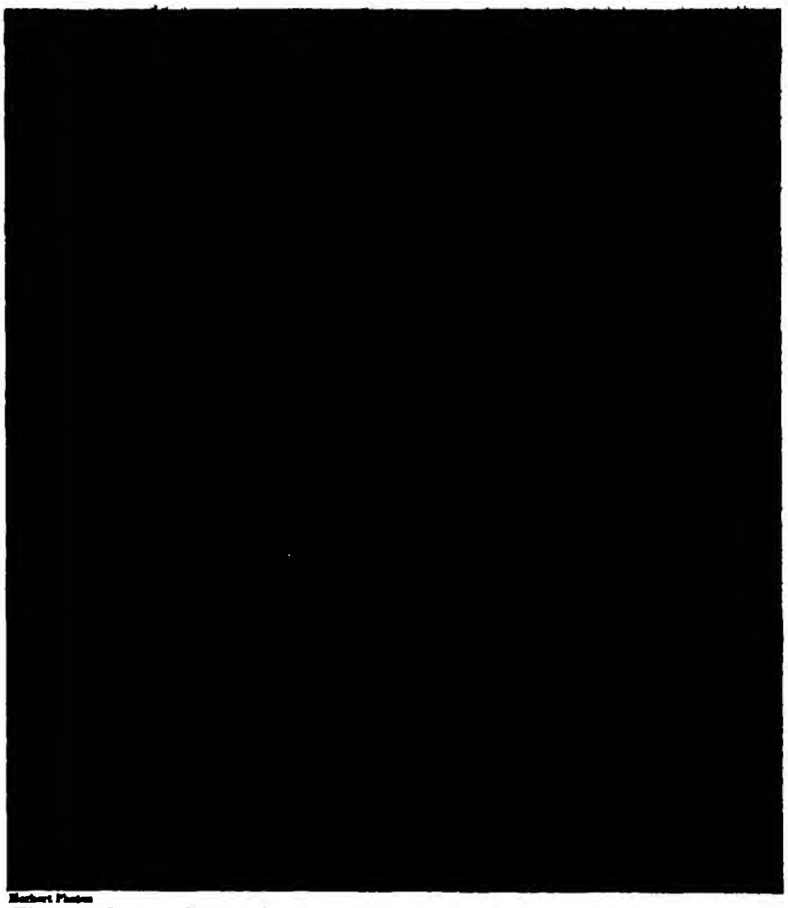
Radio Safeguards Miners

A RADIO warning alarm has been developed to safeguard miners in the Pennsylvania coal fields against explosions of coal dust and the deadly effects of gas accumulation. The use of this device will permit the clearing of the affected areas or the entire mine of the operating personnel, if the ventilating system cannot relieve the dangerous gas collection that is likely to result in explosions and fire.

The instrument is based upon the principle of electrical conductivity of various gases and brings into use the simplest of radio circuits, comprising a variable condenser, a vacuum tube, a sensitive relay and alarm bells. The variable condenser plates are charged with electric energy that is discharged only when the current stored is of sufficient strength to break down the dielectric properties of the medium separating the plates, or when the dielectric itself changes to one of greater conductivity. It is on the latter principle, the change of the dielectric medium, that the mine gas detector works. The air-spaced plate type of variable condenser in the instrument is inserted in a small duct through which air is pumped from various parts of the mine, each gallery having its own separate gas detector unit, located on the surface of the earth as part of the fan and ventilating control equipment.

While the air passing through the condenser is clear of gas and dust, the circuit remains open, but when the air carries coal dust in finely divided particles, the atmosphere between the plates of the charged condenser becomes more conductive, its value as a dielectric depending upon the amount of dust suspended in the air, until the condenser discharges. The frequency of the discharge depends entirely upon the amount of dust in the air. Each discharge of the condenser is accompanied by a closing of the relay circuit that rings the bell. The rate at which the bell rings gives a reliable check on the change of conditions below so that the operator in charge of the

The biggest and most popular radio broadcasting station in Japan has the call letters of JOCK. Located at Nagoya, it operates on six kilowatts of power and is heard in California. The above illustration shows the microphone on a special stand for Japanese performers who sit on the floor



Herbert Photos

This simple yet efficient short wave radio transmitter was built by the students of Marietta College for the American Museum of Natural History Greenland Expedition Notice the accessibility of all of the parts

control board can regulate the ventilating system to relieve the condition before it becomes a menace by either drawing out the air or forcing in a fresh draught to dissipate it

The separation of the condenser plates is dictated by physicists chemists and mining engineers who have determined when the percentage of dust and gas assumes dangerous proportions

Patent Granted Latour

A PATENT with basic claims broadly covering amplification up to the limit of oscillation with means to prevent disturbing oscillations at all frequencies in multi-stage receivers together with a common source of space current known as the B battery has been issued by the United States patent office to Professor Marius C A Latour of France

It is contended by the Latour Corporation that practically every type of radio receiver as now manufactured infringes one or more of the eighteen claims of the new patent which bears the number 1 584 701 and which is assigned to the Latour Corporation of Delaware The earliest date of priority of invention as allowed is October 2, 1916 when the first French application was filed

The evidence submitted with the application is said to show that Professor Latour was the first to produce multi-stage vacuum tube radio receivers that could be successfully operated without undesirable oscillation or noise. These were the French "L" type sets.

Reactivating Vacuum Tubes

REDUCED volume may be caused by the loss of active material on the tube filaments. The Technical News Bulletin of the National Bureau of Standards says

"Electron tubes in receiving sets eventually lose their sensitivity This sometimes progresses to the point where the receiving set operates very poorly or not at all, even though the tube filaments are not burned out. The user of the set frequently confuses this condition with that due to an exhausted "B battery

If the tubes are of the thoriated tungsten (X L) filament (it is estimated that the majority of tubes are of this type) they can usually be rejuvenated by a simple process and made to serve as well as new tubes

The process of reactivating the tubes is as follows Disconnect the B" batteries from the receiver and burn the filaments above normal brilliancy for half an hour Usually this restores the filaments to full activity

The best and easiest plan to determine whether or not the tubes are good is to have two or three new tubes on hand and from time to time substitute them for the old tubes If there is a marked improvement in volume it is an indication that the older tubes need rejuvenating

Listening in a London Book Shop

DAVID SARNOFF Vice-President and General Manager of the Radio Corporation of America, at a dinner of the Radio Club of America, told of his first experience several months ago in talking across the Atlantic via the talk bridge."

The call was given the toll operator just as any long distance telephone call is started. It was on a Sunday afternoon and before many minutes had passed he was talking with Owen D Young in London.

When Mr Young returned to New York, he related his story of the accomplishment at the British end of the line. Mr Young left his home in London to visit an old book shop and when he went out, he told Mrs. Young where she could reach him. While he was gone the phone at his home rang and the long distance operator inquired for Mr Young. She was given the name of the book shop where he could be reached. The phone tingled in the old shop and the proprietor answered Then, he said, "It is a call for you Mr Young, but I think you had better go over to the Savoy Hotel because this phone is old and rusty It has

been used for several months." However, Mr. Young took the receiver and heard the voice of Mr Sarnoff in New York just as clear as if it was a local call

Mr. Young explained upon his arrival in the United States that the reason he could not say much over the transatlantic circuit was that he was so much overcome with the wonder of hearing his friend in New York on the phone in the old book shop of London.

A Radio-Piano for WRNY

An instrument known as a "pianorad" which combines the piano and radio utilizing the howls from a radio circuit to produce musical notes has been developed for use at station WRNY

This radio-piano has a keyboard similar to an ordinary piano and there is a vacuum tube for each of the keys When a key is pressed a radio oscillator circuit is energized which creates a pure flute like tone in the loudspeakers connected to receiving sets. The musical notes produced by vacuum tubes in this manner have practically no overtones, and for that reason the music is said to be clearer than that produced by a flute

The notes are sharp and distinct and are readily distinguished from those of any other musical instrument Any number of notes can be sounded simultaneously and they can be sustained for any length of time When a key is struck on an ordinary piano the sound quickly dies away but with the pianorad the sound remains as long as the keys are depressed

The instrument at WRNY has 25 keys and therefore 25 notes A single stage of audio frequency amplification is used but by adding several more stages sufficient volume can be obtained to fill a large auditorium It is possible to build a pianorad with the standard 88-note keyboard This would require 88 vacuum tubes

Why Tubes Are Silvered

Radio fans often ask why the inside of a vacuum tube is silver colored and mirror like in appearance When the tube is completely assembled the gases and air are pumped out Then magnesium wrapped in a piece of thin nickel and held in a small side tube is heated by a high frequency induction coil until the magnesium vaporizes and condenses in the bulb giving it the appearance of a mirror The magnesium reacts with the last traces of the more troublesome gases left in the tube after the pumping operation and cleans them up, producing a still higher vacuum. The tube is then sealed and based by automatic machinery

How Tube Filaments Are Developed

The filament structure of modern vacuum tubes was recently explained over station WGY by F C Kelley of the General Electric Research Laboratory

"The filament is made of tungsten one of our rare metals" said Mr Kelley "It is more than 19 times as heavy as an equal volume of water and melts at a point higher than any other metal The tungsten is obtained in powder form and is mixed with small percentages of thorium oxide and carbon It is then pressed under hydraulic pressure into bar form If handled at this stage the bar will break, so it is supported on a solid slab of tungsten and pushed into a hydrogen furnace where it is sintered at a white heat It is then refired at a temperature just below the melting point and in an atmosphere of hydrogen by passing a very heavy current through the bar The bar sinters or shrinks both in length and cross section and the carbon reduces the thorium oxide to pure thorium metal

"The density of the bar is then about the same as pure tungsten which has been melted and can be hammered hot into round rods and then into small wire The wire after reaching a certain diameter is drawn down cold through diamond dies to filament size and this gives the final filament material"

Tungsten and Nickel In Grid and Plate

The grid of a vacuum tube is made of tungsten wire wound around two nickel supports in the form of a flattened spiral Each point of contact between the spiral grid and the supports is welded

The plate consists of a flattened cylinder of thin sheet nickel welded to nickel supports

Detector Uses Double Plate

An eight tube tuned radio frequency circuit designed by Fred A Jewell of North Carolina has been introduced by the Jewell Radio Company The receiver uses a vacuum tube detector provided with two plates instead of one plate as is the usual practice The inventor explained that the double plate allows push pull amplification in the detector and gives increased amplification with minimum distortion Two dials control the tuning

Wide World

This illustration shows the radio transmitter that Commander Byrd took to the north pole with him on his recent memorable flight. The set uses an oscillating crystal circuit for control of the transmitted wave

Learning to Use Our Wings

Aircraft are being put to use in peace as well as in war. This department will keep our readers informed of the latest facts about airships and airplanes

Conducted by Alexander Klemin

In charge, Daniel Guggenheim School of Aeronautics, New York University

An Interesting Engine

IN the modern aircraft engine it is essential to obtain high power for a given weight This is largely obtainable by a high piston speed But high piston speed in the ordinary internal combustion engine also means high speed of revolution of the crankshaft and a high propeller speed This is an excellent condition for a very speedy single seater fighter But for a comparatively slow commercial plane, high propeller speed means inefficiency The forward speed of the plane bears too low a ratio to the peripheral speed of the propeller To meet this difficulty propellers are very often geared down, with the disadvantages of weight and complication

In a new engine of almost revolutionary conception high piston speed is combined with low propeller speed without the intervention of any gears by a most ingenious mechanism

This engine is the Fairchild Caminez, designed by Harold Caminez formerly an expert with the Engineering Division of the Army Air Service The engine is illustrated in these columns

Instead of the conventional drive from the piston through a connecting rod to the crankshaft the reciprocating motion of the pistons is converted into rotary motion of the propeller shaft by means of rollers operating on a double lobed cam somewhat like a figure of eight fixed rigidly on the shaft The mechanism is such that each piston completes four strokes for every revolution of the shaft—while in the ordinary engine the piston completes only two strokes for every such revolution Therefore for a given piston speed the crankshaft revolves just half as fast as in the ordinary engine

Adjacent pistons are connected by a system of links the contour of the drive cam being so designed that these links maintain the piston rollers in continual contact with the cam. As a result the cam shows not the slightest wear under prolonged running

Another important difference of the Caminez engine from the ordinary engine is that the motion of the pistons in opposite cylinders is identical with respect to the engine axis, so that the piston inertia forces balance one another exactly

Further, since the pistons make four strokes per revolution there is no necessity for valve gearing and intermediate shafting, single lobed intake and exhaust cams are mounted directly on the main engine shaft which operates all the valves in the engine This makes for tremendous simplification

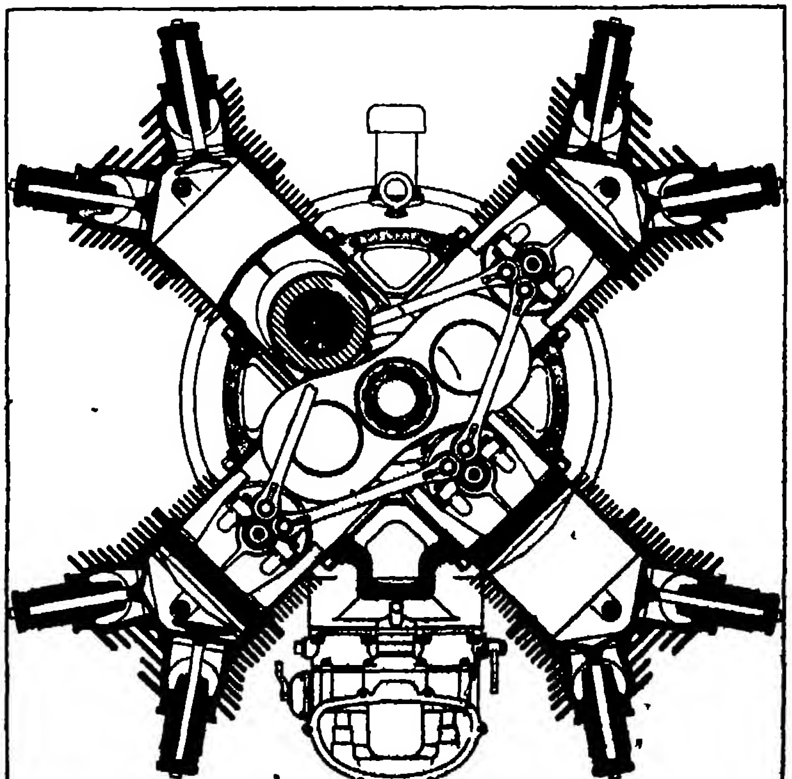
The direct action of the piston rollers on the figure of eight cam brings the cylinders closer together and therefore produces compactness, lightness and less head resistance

The beautifully made and ingenious mechanism has undergone exhaustive tests both on the block and in the air having been mounted in the well-known Avro biplane In spite of its robust construction the 150 horsepower engine only weighs 360 pounds and its projected frontal area is only 3 9 square feet

We believe that the keynote to successful commercial aviation lies in simpler and more reliable power plants There is no doubt that the Caminez Fairchild engine marks a decided step in this direction

The Kite Balloon

THE advent of the power driven airship and airplane has greatly decreased the interest in ballooning, once a most popular sport Kite balloons, a modification of the spherical balloon, attract even less attention Yet the kite balloon serves many useful purposes and its design teems with intricate aeronautical problems



A line drawing showing a longitudinal section of the engine which shows the fundamental conception of the engine even more clearly than the photograph

Wide World

Sherman M. Fairchild and Harold Caminez examining the "Cam" engine dismounted from the plane and partially disassembled. The photograph shows clearly the figure of eight cam on which the piston rollers operate and the links which keep adjacent pistons in constant contact with the cam

Kite balloons were successfully used during the war for spotting submarines, observers in telephonic communication with the patrol ship could give notice immediately of the detection of the wake or "shadow" of a submarine below the surface On the western front, kite balloons provided effective, although very hazardous observation posts. In commercial aviation it is possible that kite balloons may be employed at large airports for providing meteorological data, for wireless work and perhaps for the marking of airways.

An efficient kite balloon should be able to rise rapidly to a good altitude, offer a minimum resistance to the wind so as not to impose undue strains on the holding down cables and provide a fair degree of stability Nothing is so conducive to violent seasickness and loss of observational power as a violently oscillating captive balloon

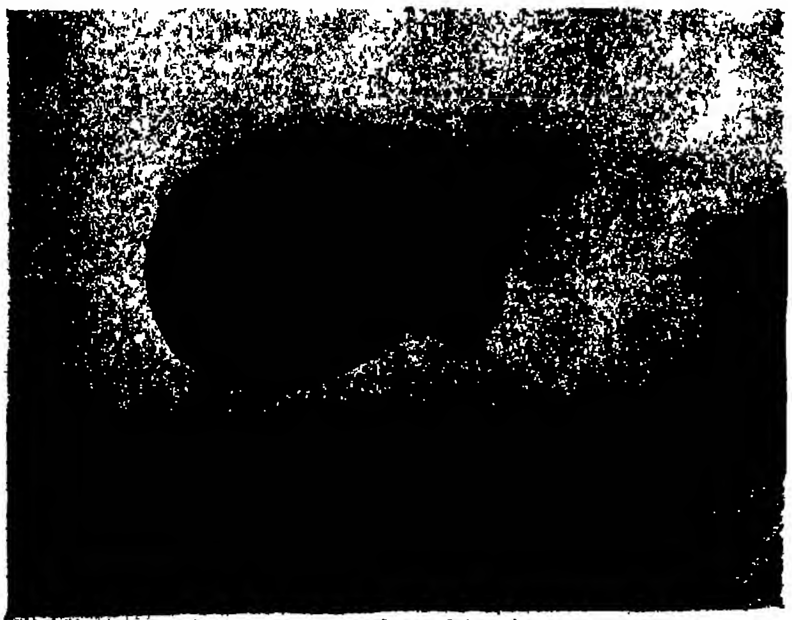
A kite balloon is used at the Navy's airship station at Lakehurst for yet another purpose—the provision of an aerial platform from which aviators may practice parachute jumping with less hazard than from a rapidly moving airplane.

The envelope of such a balloon containing the gas must be of large proportions, if it is to raise the occupants of the basket and the heavy kite cable to a fair altitude It must be streamlined, to minimize resistance to the wind. No fabric in the world could stand the concentrated pull of basket and occupants. Therefore, the kite cable at the bow of the balloon, and the basket suspension towards its center transmit their subdivided pull to a large number of running "bridles," which in turn are attached to a strong rigging band running the whole length of the envelope, with the gas lift at each section of the envelope taking a proper amount of pull.

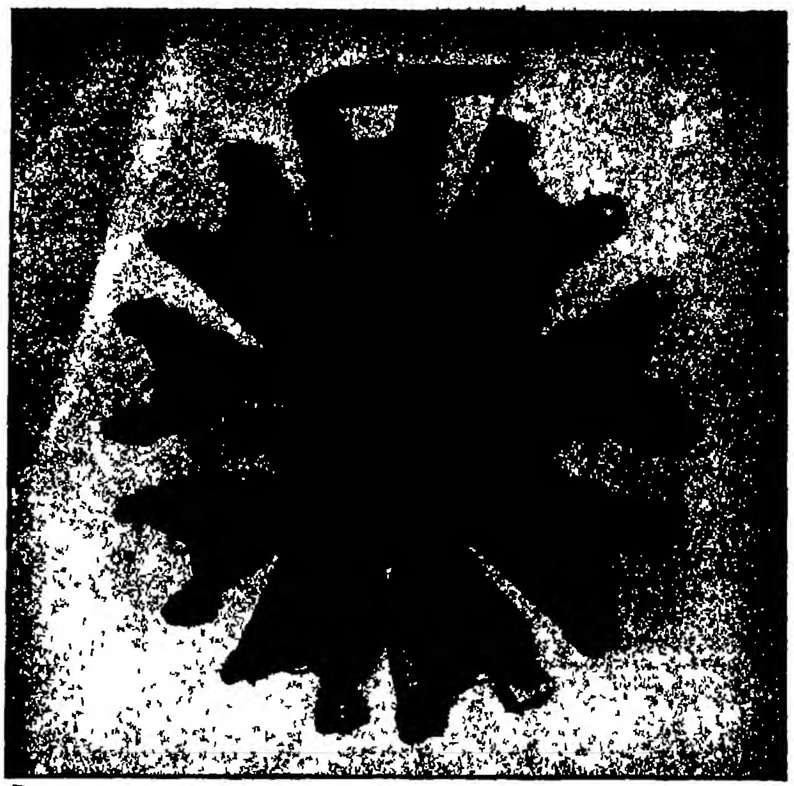
There must be provision in every kite balloon for vertical equilibrium and for the maintenance of the shape of the envelope. This is taken care of by an internal air chamber, situated more or less at the stern of the kite balloon, and entitled the ballonet Imagine the balloon fully inflated at a height of say 6,000 feet In descent the gas would contract and the balloon lose its shape It is then that the ballonet comes into play Drawing air through the scoop in the bow, it takes up sufficient air as the hydrogen or helium gas contracts, to preserve the exterior form.

To further maintain stability, either longitudinal or lateral, the kite balloon must have tail surfaces. The kite balloon has three tail surfaces; the vertical one and two others at sixty degrees to the vertical When the gas has inflated the envelope it also inflates the tail surfaces, which are handier, lighter and more practical in every way than any solid fins that might be applied to the envelope.

Perhaps these brief lines will serve to



Wide World The kite balloon which may be used for observation purposes



Front or propeller end of the "Wasp" air-cooled engine showing compactness and "cleanness" of the design, with the valve gear enclosed to offer minimum air resistance and thus increase efficiency

give the reader an incentive to further consideration of these apparently simple, yet in reality complex contrivances.

A New Air-Cooled Engine

SOME few months back we discussed the respective merits of air-cooled and water cooled engines. The controversy seems to be rapidly closing in favor of the air-cooled type The new "Wasp" engine, built by the Pratt and Whitney Aircraft Company, is a case in point

The famous Liberty motor which is rated at 400 horsepower, weighs 837 pounds The D-12 water-cooled, twelve-cylinder engine delivers 425 horsepower at 2,100 revolutions, weighs only 720 pounds and is a marvel of engineering skill The "Wasp" also delivers 425 horsepower at 1,900 revolutions per minute, yet only weighs 650 pounds When we consider that the water-cooled type needs a radiator, water in cylinder jackets and radiator, and a system of pumps and piping, the whole weighing between 150 and 200 pounds, it can be seen that the advantage in point of weight for the air-cooled type becomes very important

So far the air-cooled engine has not achieved its full possibilities because designers did not know how to cool it sufficiently for higher compression ratios and speeds of revolution. As its cooling becomes as simple a matter as that of the water-cooled type, we may expect its weight per horsepower to go down still further The inherent compactness of the star-shaped, air-cooled engine of necessity makes for light weight.

The "Wasp" also offers interesting points in the decrease of head resistance, an item just as important as lightness. The resistance of the engine to the rush of air has been diminished by four distinct lines of attack. First, the projected area has been made as small as possible, the over-all diameter of the engine is at least six inches smaller than that of the Bristol Jupiter, an air-cooled engine of the same power. Next all the valve gear has been enclosed, including push rods, valve springs and rocker arms. The resistance of parts projecting beyond the cowling is thus reduced to a minimum. By careful design of the cooling fins, the amount of engine which it is necessary to project beyond the cowling has been reduced. Further, all of the accessories, such as magnetoes, carburetors, and oil and fuel pumps have been placed at the rear; as a result, the airplane designer is able to make the front cowling of streamline form.

Our photographs illustrate some of these characteristics. One shows the front or propeller end, with the valve gear enclosed, while another gives a side view of the engine with the accessories in place at the rear We also show a photograph of the Navy shipboard plane, the *Apache* The cowling covers almost the entire engine and is nearly prefect in its streamline.

The use of the air-cooled engine has enabled both speed and climb for shipboard planes to be improved and the overall size of the plane to be diminished, which is a very important consideration from the point of view of stowing below decks.

Incidentally it is worthy of note that the carburetors on the "Wasp" are provided with a system of rotary induction which distributes the gas uniformly to all cylinders. There is no doubt that such practice is likely to be used extensively on aircraft engines of the future.

The Future of the Flying Boat

COMMANDER H. C. RICHARDSON, one of the foremost authorities on the design of seaplanes, in a paper before the American Society of Naval Engineers summarizes in interesting fashion the trend of flying-boat design.

Apparently the practical limit of size has not yet been reached. Seaplanes of a gross weight of 30,000 pounds and more appear entirely practicable. With land planes, increase in size entails many difficulties, both in handling on the ground and in the enormous hangars which are required. With seaplanes, increase in size has the overwhelming advantage of producing greater seaworthiness; large seaplanes have shown remarkable handling qualities in quite rough seas.

Multiple engines will be used because of the difficulty of getting sufficient power in a single unit and because of the added security of the multiple power plant.

Air-cooled engines will gradually displace the water-cooled engine with its many troubles.

The fuel will gradually change from gasoline to heavy oil, reducing the cost and eliminating fire hazard.

The hull will no longer be the water-soaked wooden structure now familiar, but will be framed and plated with metal, either

alloy steel or duralumin. It will be well subdivided and probably have a double bottom.

Some form of servo-motors will be employed on larger seaplanes to operate the controls. In a large ship and on long flights the muscular demands on the pilot are already excessive.

In seagoing planes, the monoplane will probably dominate. The wing is far higher from the water than the lower wing of a biplane, and is *therefore* less subject to damage in heavy seas.

Just as an ocean liner carries a number of auxiliary engines in addition to its main power plant, so the seaplane will ultimately be equipped with small auxiliaries for the handling of anchors and lines, drainage, lighting, signaling, and possibly an auxiliary engine in conjunction with a marine propeller to provide for propulsion when afloat.

On passenger planes, life rafts will be provided.

Landing speeds will be under 50 miles per hour, and high speeds may reach 130 miles per hour for even the very largest craft

Apparently the day is rapidly coming when the seaplane will be large enough and well enough equipped to be entirely serviceable for commercial operation.

Steam Power in Aircraft?

THE remarkable reliability of the steam-power plant in ocean-going vessels, causes engineers and inventors to revert again and again to the question of steam power in aircraft. Another reason why steam power for the airplane is of interest is the fact that while the internal combustion engine loses power rapidly with increasing altitude, the steam power plant increases in horsepower and efficiency the lower the pressure of the exhaust, and has therefore everything to gain in altitude flight. Experimentation and analysis do not seem, however, to give much hope of steam utilization in flying. Commander E. E. Wilson in a Technical Note of the National Advisory Committee for Aeronautics, takes an unfavorable view after serious study

The modern airplane engine challenges the use of steam with the following figures Its weight is less than three pounds per horsepower and it consumes only one-half pound of fuel per horsepower-hour Its reliability is constantly increasing, failures remaining frequent only in the "plumbing."—water, gasoline and oil lines and systems, where reduction of weight has been carried beyond the point where reliability can be maintained. This plumbing is being rapidly improved, and by the use of air-cooled engines, one very important phase of the plumbing disappears entirely

Now examining the steam-power plant, we see that it must comprise a boiler, the engine; auxiliaries, and a condenser because no aircraft could possibly carry sufficient water on board to operate a non-condensing engine.

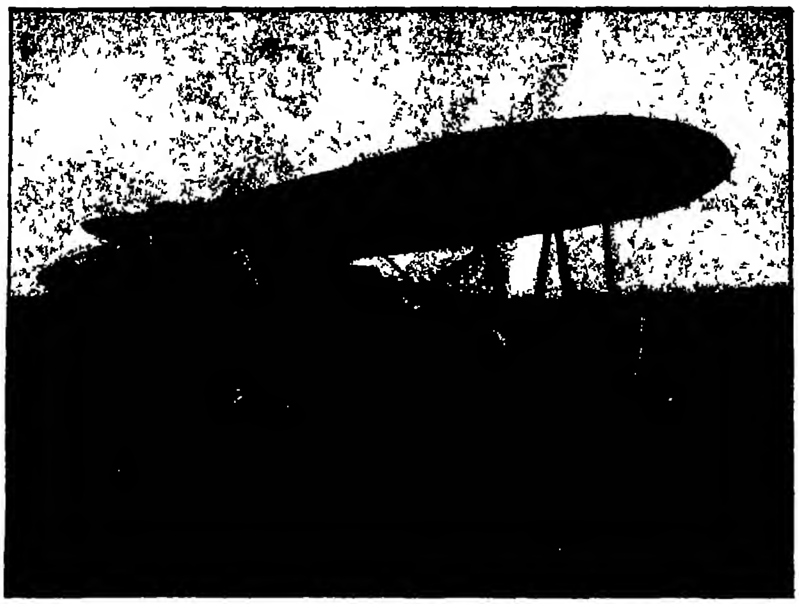
To challenge the internal combustion engine, the steam engine must be a high-speed turbine, with considerable speed reduction to the propeller, and since the efficiency of the ordinary steam turbine is such that the fuel consumption is one pound per horsepower-hour, instead of the half pound figure in the present aircraft engine, the steam turbine must work at pressures far exceeding those hitherto employed. Something of the order of 1,000 pounds per square-inch pressure would have to be employed to make up for the inherent inefficiency of the steam engine cycle as compared with the internal combustion engine cycle. Commander Wilson concludes that only in very large units and with such pressure could a steam turbine be developed weighing one pound per horsepower and having a fuel efficiency equal to that of the internal combustion engine.

But with this enormous pressure of 1,000 pounds per square inch, is it not likely that the greater reliability of steam operation will vanish? Yet in a crash, the possibilities of damage with steam at this enormous pressure are terrible!

On the other hand, with the steam turbine, it would be possible to use a heavy fuel, lessening operating cost and to some extent the fire hazard

The turbine itself is far from completing the steam power plant We must have a boiler, or steam generator From weight considerations the only possible type of boiler is the flash boiler, consisting essentially of a system of tubing into one end of which feed water is forced, while from the other end steam issues. No storage space for either surplus water or steam can be provided, and hence more or less complicated devices must be introduced to maintain the proportions of fuel and water supply at desirable values under sudden fluctuations of load. Fire brick or other refractory lining for the combustion chamber must disappear because of prohibitive weight. The combus-

Side view of the "Wasp" engine. All the accessories are placed at the rear



The "Apache," a navy shipboard plane equipped with the "Wasp" engine. Little of the engine projects beyond the cowling, and because the various accessories are at the rear of the engine, the airplane designer has been able to blend the lines of the cowling smoothly into its fuselage. Side doors in the cowling give ready access to magneto, carburetor, et cetera

tion chamber must be enclosed in walls of steel tubing, through which the steam generated in the heating coils passes and becomes superheated. In an actual steam generator constructed, the boiler consisted of 16 parallel streams of half-inch flat tubing in which the steam was completely evaporated, and then passed through seven larger tubes for superheating. Fans, pumps and other auxiliaries had to be added to the generator proper.

Commander Wilson concludes that a suitable generator could be produced weighing two pounds per horsepower complete, and having adequate thermal efficiency.

The steam plant then apparently would meet the requirement that it should weigh not more than about three pounds per horsepower.

But there remains the question of condensation.

The internal combustion engine needs far less cooling than the steam engine, because in steam work, the vapor must be re-converted to water and the latent heat of steam is enormous. Exact computations show that with a turbine which must function at low pressure to be efficient, the steam plant would require 11½ times as much radiator surface as the internal combustion engine of the same power.

The weight of the steam-plant radiator therefore becomes prohibitive. And further, the horsepower required to pull the enormous radiators through the air would equal the horsepower required for the propulsion of the entire plane!

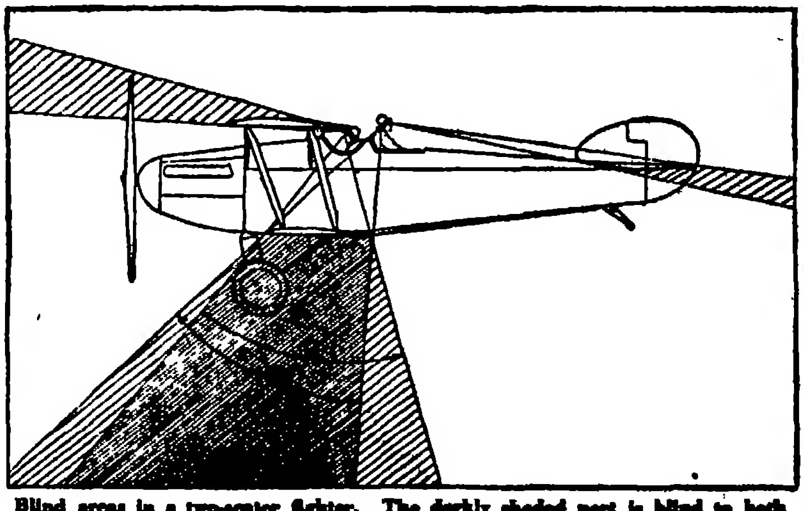
Is it possible to eliminate this process of condensation to some extent? Perhaps by the use of a mercury boiler, in which the heat of condensation of the steam is transferred to the mercury which in turn is utilized in a turbine, so that only the condensation of the mercury remains to be dealt with. In the mercury steam plant, the high boiling point of the mercury also reduces the pressures required, and because of the high molecular weight of the mercury, smaller turbine dimensions become possible.

Commander Wilson thinks it possible that a steam-mercury plant might be developed for about five pounds per horsepower, in which much of the cooling surface required would be reduced to practical proportions and an efficiency equal to that of the internal combustion engine attained.

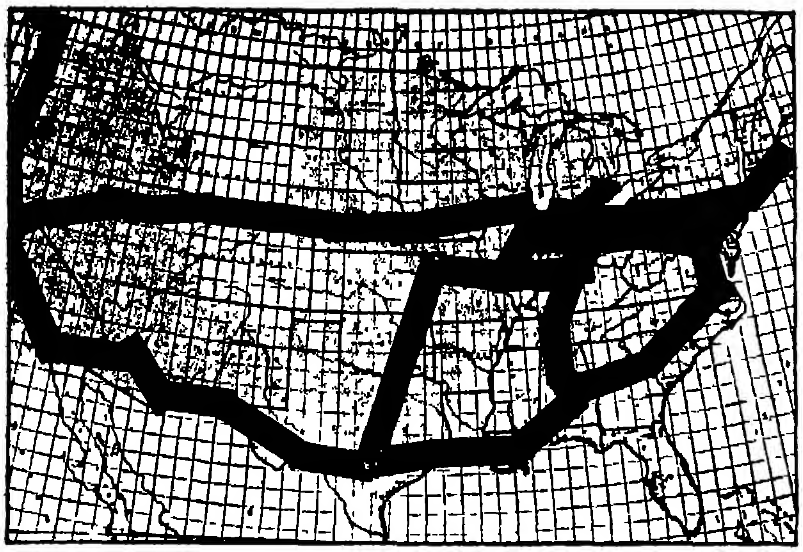
But the very reason why we are seeking to use steam is simplicity and reliability. The inventor or engineer who would seek to use a mercury-steam plant aboard aircraft might run into even greater complications than harass us at present.

Air Strategy and Tactics

WE have recently received from Longmans, Green and Company, New York, a small book entitled, "The Strategy and Tactics of Air Fighting," by Major Oliver Stewart, and we have read it with the great-



Blind areas in a two-seater fighter. The darkly shaded part is blind to both pilot and observer. The fuselage causes an additional narrow blind area underneath. The elimination of blind areas is one of the most difficult problems in the design of military airplanes. Also, in peace as well as in war, blind spots are always a potential source of danger



Flying maps cover much of the area shown by the bands of diagonal hatching. In the shaded states, the principal air routes are being sign-posted

est interest Aerial combat is often thought to be a matter of reckless bravery and dash. Bravery and dash the air fighter must have, but he must also be imbued with principles of strategy and tactics, and think out his plan of combat more carefully even than the soldier on land

Supposing New York City were in danger from a night attack by air, methods of detection would become of paramount importance The French system for such work is particularly interesting. Many special lamps which threw very wide beams (not searchlights) are directed upwards from the ground A friendly machine flies high over the lamps and when the enemy machine passes between the friendly machine and the lamps, the enemy machine shows, to the watchful aviator, as a shadow crossing a lake of light.

Even in broad daylight it is harder to keep track of a plane than would be imagined Major Stewart gives a graphic example. In the war it was common experience for a patrol leader to lead a patrol containing a novice into battle with an enemy formation. Upon the breaking off of the combat, the novice would be missing. Back at the airdrome, he would be found to have landed safely and to have seen not a single enemy airplane! The novice had lost his squadron completely

In most airplanes there is some region in which, owing to the position of the wings or tail surfaces, gun fire cannot be directed. Every designer of military aircraft has struggled to eliminate these blind spots, since the attacker gains an enormous advantage by approaching in the shelter of such a spot The appended diagram shows this condition of affairs clearly for a very well designed two-seater

Air fighting involves the most curious maneuvers and their study is one of the most intricate problems in dynamics. The book describes these maneuvers in a particularly clear and interesting manner

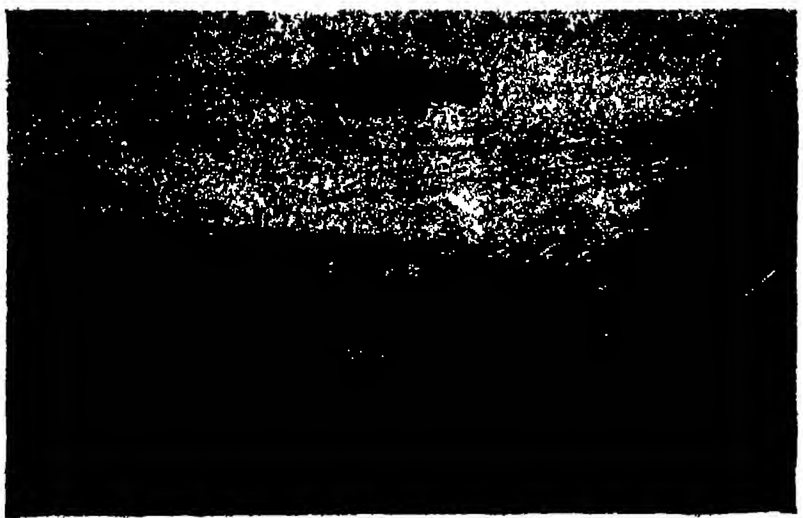
We wish we had space to deal with more of the fascinating problems and ideas brought up by the author

Mapping and Signs

JUST as important to the operation of commercial airlines as weather information signs, is the provision of maps and air signs. Intensive work is being carried on to provide such maps and signs for at least those portions of the country where flying is being carried on regularly and intensively In the accompanying chart, which is reproduced by courtesy of the *National Aeronautic Association Review*, is shown the territory already covered by 48 maps prepared by the Engineer Corps of the Army and the Air Service These charts show the characteristics of the territory, shape of the cities, elevations of the ground by a series of colors railroads, rivers, et cetera. The maps also show "route lines," indicating the preferable flying route between cities with regard to the availability of emergency fields.

Air signs are also rapidly covering the country, particularly in the west Town and city names in letters eight or ten feet high have been painted on black backgrounds on tanks and buildings. Landing fields are being marked by 100-foot circles of crushed stone or cement. The Standard Oil companies are particularly active in this route marking.

While Europe is relying on ineffectual subsidies, in the United States a more effective aid to commercial air transport is being planned. It embraces a system of aids to navigation in the form of maps and signs.



Kadel & Herbert

Uncle Sam's giant aircraft carrier, the *U. S. S. Langley*, headed out to join the fleet, with fourteen airplanes on her "take off" deck

Dispelling Fog

IF fog over a landing field could be dispelled at will, one of the most difficult problems in aviation would be solved. It is therefore most pleasing to hear that the Navy Bureau of Aeronautics has made some successful experiments in this direction.

Navy experts estimate that 277,000,000 cubic feet per minute of fog drift through a vertical plane having a radius of 1,000 feet with its center at the ground, when the speed of the drift is two miles per hour. There is therefore an immense amount of fog to deal with under not uncommon conditions. Yet electrically charged curtains in one type of navy apparatus have been found capable of precipitating 95 percent of this fog.

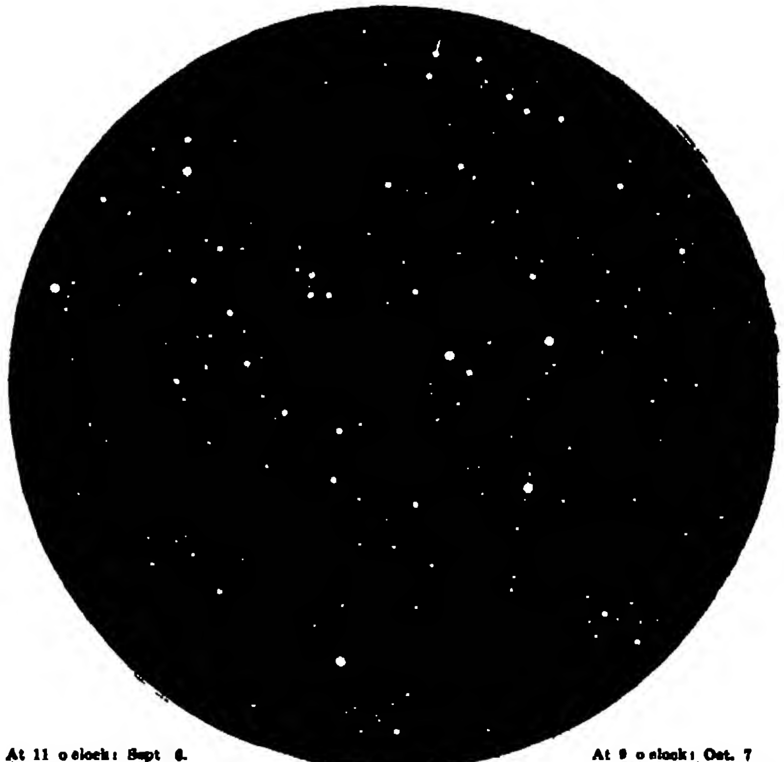
This apparatus consists primarily of a simple type of corona screen, a transformer with rectifying apparatus, an airplane propeller and a motor, all mounted on a truck.

The corona screen charges the air electrically, and is capable of charging 700,000 cubic feet per minute. The propeller, driven by a 400-horsepower motor mounted on a swivel, discharges this air into the imaginary vertical curtain of 1,000 feet radius. The oncoming fog meets this charged air and is itself charged. As the fog passes over a projected electrostatic field, the fog particles are driven together and precipitated.

Many more experiments are necessary to determine the distance to which the electrostatic field can be projected; how the corona should be set up, what is the proper voltage to use and so forth.

The Heavens in September

By Professor Henry Norris Russell, Ph.D.



At 11 o'clock: Sept 6.
At 10½ o'clock Sept 14.
At 10 o'clock: Sept. 21
At 9½ o'clock: Sept. 30.
At 9 o'clock: Oct. 7
At 8½ o'clock: Oct. 15.
At 8 o'clock: Oct. 22

The hours given are in Standard Time. When local summer time is in effect, they must be made one hour later: 12 o'clock on September 6, etc.

NIGHT SKY: SEPTEMBER AND OCTOBER

The Heavens

ON our map of the heavens this month we find the Milky Way in a great circle overhead, from Auriga in the northeast, through Perseus, Cassiopeia, Cepheus, Cygnus (at the zenith), Lyra, Aquila and Saggitarius to Scorpio, setting in the southwest Ophiuchus, Hercules and Boötes are the most conspicuous groups in the west, Draco and the two Bears in the north, Pegasus, Andromeda and Aries in the east and northeast, and Aquarius, Capricornus and Pisces Austrinus in the dull southeast.

The Planets

Mercury is a morning star until the nineteenth, and an evening star after that date, but he is well visible only at the beginning of the month, when he rises about 4 A.M.

Venus is still conspicuous as a morning star, rising about 20 minutes before Mercury on the 1st, but remaining in sight after the latter has passed to the other side of the sun

Mars is growing more conspicuous as he approaches opposition. In the middle of the month he rises at 9 P.M., and looks almost as bright as Sirius. He is only about 50 million miles away and telescopic observers will be actively engaged.

Jupiter is now best visible in the evening, coming to the meridian at about 10 P.M., while Saturn is well down in the west at sunset, and sets between nine and ten o'clock.

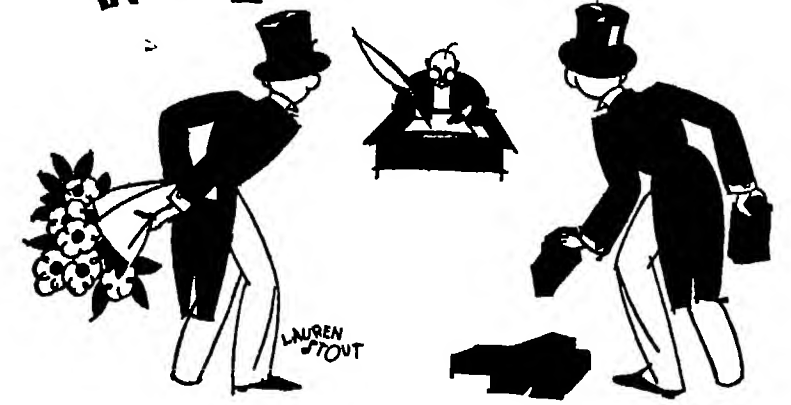
Uranus is in opposition on the 21st. On that date he is in 23h 52.0m R.A. and 1° 44' south declination, and is moving 8.8 west and 57" south per day He is in the constellation Pisces, but not near any bright stars that might help to pick him up, so that a good star map is required.

Neptune is just past conjunction with the sun, and is practically unobservable.

The moon is new at 1 A.M on September 7th, in her first quarter at 11 P.M. on the 14th, full at 3 P.M on the 21st, and in her last quarter at 1 P.M. on the 28th. She is nearest the earth on the 21st (when we will have very high tides, but *not* on account of the equinox), and farthest off on the 7th. During the present month she is in conjunction with Venus on the morning of the 8th, Neptune later the same day, and Mercury that evening, with Saturn on the 12th, Jupiter on the 18th, Uranus on the 21st, and Mars on the 25th, none of the observable approaches being close.

At 2:27 P.M. on the 23rd, the sun crosses the celestial equator, and "autumn begins."

IN THE EDITOR'S MAIL



Another Answer to the Crossing Problem

The elimination of accidents at railroad crossings is still an unsolved problem. Among the many suggestions received, we believe that of Mr. Sambert has considerable appeal as it involves little expense and is practically foolproof, not depending on any mechanical contrivance

Editor, Scientific American:

With reference to your May edition, page 341, letter W W Ward, on the subject of "Prevention of Accidents at Railroad Crossings."

I wish to submit to your attention a solution which I believe to be superior to any similar solution, as yet offered and published.

As a matter of fact, I believe that it is the only logical solution under ordinary conditions, since it is far more simple, economical, practical and foolproof than any other solution known to the writer

However, please, judge for yourself

I propose that a piece of the road, about 100 feet long or more, on each side of the railroad track, shall be left in a more or less primitive or indifferent condition, without, of course, allowing such a condition to become dangerous to any degree.

The bumps and depressions in these short stretches of the roads shall be most pronounced at a distance of about 20 or 30 feet from the railroad tracks. In this manner, the gradual increase of bumps and depressions in a road would not only warn a driver of the proximity of railroad tracks, but it would force him to slow down, as he always should, or else it would make him pay the immediate penalty of a severe shake-up of his and other peoples' anatomy plus car, something very few people seem to care for

This method of discouraging and preventing speeding across railroad tracks is absolutely foolproof, because its efficiency does not depend upon weather conditions, et cetera, nor upon the reliability of some specific mechanical device.

The cost of installation is less than nothing, since its installation is coincident to the actual saving of public funds (which become available for better purposes) Why spend money to build and to maintain good roads right up to the railroad tracks? Why tempt the speeder to do that very thing which we are all trying to keep him from doing? It seems illogical to first spend money for one thing and then to spend more money to eliminate certain unwanted consequences of the first expenditure.

I also believe that the average foreman of a road building or repair gang would be glad to lend his cooperation, and that these men are quite competent to understand what kind of a bumpy piece of a road would be wanted for this particular purpose, if the mere omitting of repair work should fail to accomplish it Experiments in this direction could be made very easily under various conditions and without any extra expense.

May I not suggest that the Scientific American (which has done so much valuable missionary work for the promotion of safety and for the prevention of traffic accidents) communicate with a number of progressively managed insurance companies, railroads, and automobile owners' associations, for the purpose of securing their individual opinions on the subject discussed in this letter?

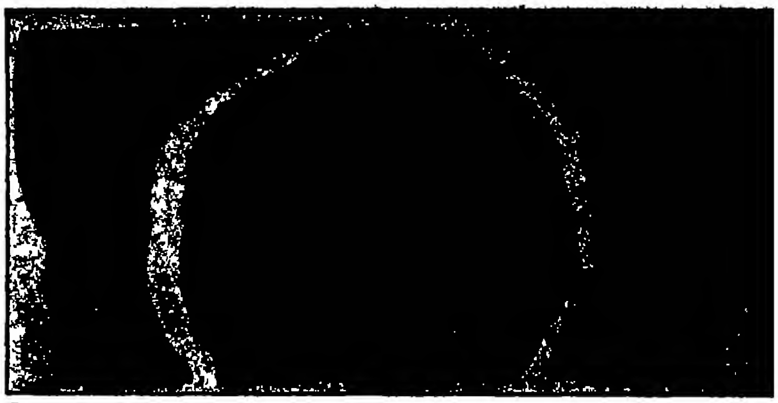
Yours Very truly,
J Sambert

A Tree that Swallowed a Tree

Last month we had a note about an egg within an egg. Now we have a tree within a tree. This fir tree that swallowed another was brought into the sawmill at Springfield, Oregon, and our contributor, Charles Oluf Olsen, describes it thus

Not long ago a butt fir log nearly four feet in diameter was brought into the sawmill of the Booth Kelly Lumber Company, Springfield, Oregon. During the process of sawing it was discovered that here was a tree that had evidently swallowed another one Counting the growth rings, the larger outside tree

The tree within a tree as it was found after the sawmill had removed the outside layer of the larger of the two. The inner one had stopped growing



In this view, the saw has cut to the inner tree and the remaining parts of the outer one have been pulled apart to show the complete tree within

was estimated to be 215 years old and the little inner one, 15 inches in diameter, 110 years old, at the time of cutting

When and how the swallowing process took place is a matter of conjecture, but no doubt the two trees originally stood closely side by side, and in the course of growing came to press against one another to such an extent that they gradually became one When the two trees first touched, both were young, the larger not much over 50 years old and the smaller around 35 The larger and more powerful slowly enfolded the smaller until it died from want of sun and air, after a struggle of many years' duration. Then the larger tree, evidently satisfied with its victory, kept on growing until the woodmen's axes laid it low about 75 years later

The photographs show only the center section of the log, the outside slabs having been cut off before the interesting phenomenon was observed.

One on Us

Who says a Scotchman has no sense of humor? The pleasant chuckle we indulged in upon reading the letter below took most of the sting out of the fact that we had made a blunder

Editor, Scientific American,
Sir

On page 64 of the July number of the Scientific American there appears a photograph of a gentleman explaining certain features of an aeroplane to a number of schoolboys, and the explanatory paragraph under the photograph commences as follows "The master of Sempill," "an English school, recently . . ."

Well, Sir, you certainly did drop a brick there "The Master of Sempill" is a Scottish title and is borne by Colonel The Honourable William Francis Forbes-Sempill, only son of the 18th Baron Sempill.

I bring this to your notice not in any spirit of derision, but rather as an item of interest to you, as I have been for some time past an interested reader of the Scientific American.

I may say that as I am a Scot, I read it in the local free public library

Yours faithfully,
James Watt,
Portsmouth, England.

"Toonerville"

Somebody in Wales, North Dakota has not been "playing the game." As most of us know, an electric flatiron consumes very considerably more current than, for example, an electric lamp. It would appear that some citizen of that otherwise peaceful Dakota community (not listed as incorporated—Census of 1920), unmindful of civic duty, has been using one of these power-greedy domestic aids in excess of the three-horsepower capacity of the town dynamo to supply "juice." Here is a fine state of communal anarchy!

Yet the diplomatists of the Electric Light Association of Wales were equal to the occasion. Here is what, according to a clipping sent in by one of our readers, they wrote their several patrons:

Regarding electric power on Tuesdays—the plant will only put out 20 amperes. An iron pulls about five amperes and a motor for washing about two amperes. The plant will thus handle only four irons at one time. There are eight who have them and the four to use it in the morning are Mrs. George H. Johnson, Mrs. George Lachner, Mrs. Jo Levin and Mrs. Plata. The other four in the afternoon are Mrs. Fischer, Mrs. Fraser, Mrs. Nelson and Mrs. Wareburg. If any others want to use power at this time they will have to see the engineer

It is for your own good to observe these rules. If more go on than the plant will handle you will not get the power you want, and besides, you will hurt the engine by overloading.

Who's to Blame for Road Corrugation

This reader believes that the automobile is not guilty, in spite of what the United States Bureau of Public Roads has to say about it. It is his honest conviction that the metal blades used in scraping and repairing road are the cause of all the trouble. Do you agree with him?

Editor, Scientific American,
Dear Sir:

In the Scientific American Digest for the current month I note with interest that a research is being conducted to fix the responsibility of that abomination of the public highway, the "washboard" or corrugated surface.

I drive considerably over all kinds of roads throughout the western states from Kansas to California and have found the effect of corrugated roads on my light car not only disconcerting and nerve-racking but dangerous to a high degree. A little loose gravel superimposed on a corrugated surface imposes a skidding effect to a light car and I have twice been shot off the road where only the lucky circumstance of low embankments has saved me from disaster. Hence my interest in the discovery of the criminal guilty of assault and battery on the public highway

With all due respect to the United States Bureau of Public Roads, however, I very much doubt the possibility of fixing the crime on the automobile, the tires or any other part thereof, with the multitudinous variation in their vibrations and consequent erratic pounding of the road surface. Were these the causes why should not all roads be corrugated and not just "some" roads, as the heading to your article sets forth.

I have settled this problem in my own conviction unscientifically, no doubt, but to my entire satisfaction. Whether I am right or wrong in my deductions I leave others to judge and, as a possible contribution to the abatement of a menace and nuisance to the motoring public, I beg to submit my theory and the proofs thereof.

In my travels about the country I have noticed that wherever the worst corrugations occurred there was used invariably in road repairing a wide steel scraper, with a curved blade actuated to bring greater or less pressure on the road surface as it was hauled along.

(Continued on page 284)

As Professor Sheldon Says:

"Taking this as it is, without intention of improvement or change, perhaps the individual with some special interest may see a method of adapting it to his own purposes."

He is speaking of a distinctly new type of rectifier and his remark quoted above appears on page 187 of this issue of the Scientific American.

But he might have been speaking of the Scientific American itself. How many a man is there, who has picked up a copy of the Scientific American, started to read it without any intention of change or improvement in his living conditions, and found some special interest for himself, some "method of adapting it to his own purposes?"

Then do you know what the now-and-then reader does? He becomes a regular reader—a subscriber. He wants to make sure of getting the Scientific American every month, regularly, without fail, so he may not miss the things of value in every issue.

Try it. Every month you will find it not only interesting, but of practical value, "adapted to your own purpose." Here is a special inducement for you—four thirty-five cent issues—October, November, December and January—for only a dollar if you use the coupon on this page.

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In parts where there was less corrugation, or none at all the grading was done by rolling or by heavy harrow like drag, its beams bearing heavy steel edges, which led me to the only natural conclusion possible In support of this inference I submit that I know a number of roads in Mexico leading to important mining camps that are submitted to a constant traffic of automobiles, both passenger and truck that have not a sign of corrugation and which—though bad enough in parts and at times—are never repaired unless they become impassable and then by hand—no scrapers

If circumstantial evidence is admissible I might advance the Bertillon system of fingerprints or handwriting in support of my theory

Try eating an apple by scraping the flesh with the blunt point of a case knife even as our grandmothers used to do in the toothless age and unless you go carefully and lightly you will soon develope a corrugated surface the hummocks or ridges of which will be spaced with almost mathematical precision Or take a light garden hoe and try scraping the hard smooth surface of a clay soil You will not only develop corrugations but the harder you bear down the deeper they will become

I believe that road corrugations are caused by the natural vibrations of metal blades used in scraping and nothing else

And so in pleading not guilty" in behalf of the automobile the defense rests

Very truly yours
R I O Neill
Nogales Arizona.

New Light on Boy Scouts

It generally has been agreed even by boy scout officials that the boy scout movement originated in England and that the American organization was patterned after its British cousin Now however evidence is pouring into the Scientific American offices as a result of Milton Wright s article on Budding Scientists tending to show that the boy scouts originated in this country

It sounds reasonable The general plan is characteristically American the wood craft and other lore is distinctly American and even the terminology is more American than English To this internal evidence however we add the two letters below one from S Keith Evans and one addressed by Daniel Carter Beard father of the Boy Scouts of America to Mr Evans

Editor Scientific American

I think you may be glad to have called to your attention an inaccuracy which appears in the June issue of Scientific American on page 382 in an article entitled Budding Scientists" by Milton Wright

A picture of Dan Beard is inserted at the bottom of the page and it says that he was the founder of the boy scouts in 1910

Actually the foundation of the boy scout movement the world over was an organization of boys under the name of the Sons of Daniel Boone which was originated and carried on by Dan Beard for a number of years prior to 1906

The Sons of Daniel Boone was originally a department in the old *Recreation Magazine* This department was taken over by the *Woman s Home Companion* in 1906 I think it was about that time or a little later that General Baden Powell started the same movement in England modeled on the Sons of Daniel Boone but gave it the name of the Boy Scouts" because Daniel Boone was not known among the boys in England and while it is correct to say that the boy scout movement was founded by Dan Beard the date of 1910 is about six years out of the way

Sincerely yours
(Signed) S. Keith Evans.

Mr S Keith Evans,
247 Park Avenue
New York City

My dear Colonel Evans

The Boy Scouts of the Sons of Daniel Boone were organized in 1905 Each individual was called a "scout" or a "tenderfoot." You will find in the *Woman's Home Companion* that Baden Powell himself in writing for the Society spoke of them as scouts" and of their work as "scouting" This is also in your old magazine In 1907 at the suggestion of your editor Mr Arthur Vance I made an appointment with the President of the United States and went to Washington was received alone in the Cabinet room where I had a personal interview with President Roosevelt and he not only endorsed the scout idea then and there but he sent me to Major General Bell and Admiral Dewey and they both endorsed the idea, having been requested to do so by the President. All of them gave their names to badges of heroism and merit badges which are the grandfathers of the merit badges now used in the boy scouts.

I wish you would write to General Milton Davis New York Military Academy Cornwall-on Hudson New York, and get his account of my visit to Major General Bell He was there at the time and remembers the details much better than I do and I would like to have his statement in writing You can ask it of him better than I can because you are a disinterested party looking up historical data connected with your own work and your own magazine I have heard General Davis tell of our meeting there in a most interesting manner Get him to dictate it while this information can be gotten together Dewey is dead, Bell is dead Roosevelt is dead but Davis is with us

Hastily and affectionately yours,
(Signed) Dan Beard.

Organize a Club in Your Home Town

Enthusiastic amateur telescope makers from a number of cities have written us to inquire for the names of other enthusiasts living in the same communities and with the list given have organized local telescope clubs Here is a typical letter from one of these organizers

Editor Scientific American

Your sending me the names has allowed me to get them together and we have had meetings with much mutual help We are thinking of associating as the "Rocky Mountain Amateur Telescope Maker s Club We are all progressing fairly well with our telescopes at different stages some still grinding, others polishing We have patterns nearly completed for castings in brass for mountings similar to the "Springfield Mounting" There is one real mechanic, Mr Haberl who is much help to us, while some seem to excel in theory Thus we hope to obtain excellent results by reason of our association

H A Davis

An Old timer Returns

In communicating with us regarding a subscription Mr Foran sends us the bouquet that is reprinted below We wish to thank him for it and hope that the opinion which he formed years ago will be borne out by all forthcoming issues of the Scientific American We will do all in our power to make this a fact.

Editor Scientific American

I am prepaying postage on so much usable writing space that I am tempted to use it for telling you that I made the acquaintance of your magazine a very long time ago but lost sight of it in the turmoil of a life that touched science somewhat eccentrically

I came across it again a couple of years ago to find my youthful impressions of your periodical well confirmed. What I admire about the Scientific American is the intensely interesting and enlightening way in which it treats all its subjects No pains appear to be spared to make the most abstruse subject comprehensible by an average mind. It is really a godsend to find that when—under the proper stimulus—the scientist can be induced to descend from the rigorous heights where his lofty thoughts are usually evolved he can charm so supremely the man of common understanding

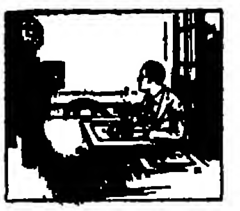
Robert Foran,
Dublin, Ireland.

Commercial Property News

A Department of Facts and Notes of Interest to Patentees and Owners of Trademark Rights

Conducted by Milton Wright

Don'ts for Inventors



MANY an inventor uses his employer's time and facilities to perfect an invention on his own account There are several objections to such a practice It is dishonest. It also is unsafe Your employer, finding that you are stealing the time for which he pays you, is likely to divorce you from your job and from the facilities for study and experiment which you need If you are not hired to be an inventor, and if there is no agreement that your inventions belong to your employer, you, and you alone, are entitled to a patent on what you invent But it is far better to get your knowledge, your experience and even your ideas in the place where you are employed and then work out the invention in your own spare time *Don't use your employer's time and facilities to make an invention on your own account* Should you do so, and the invention be even remotely within the scope of your employer's business, he would have a shopright or license to continue the use of the invention.

That Famous Irish Lace

AMERICAN firms have been importing lace from China, the Federal Trade Commission finds, selling it to manufacturers of garments to be used for trimming and calling it "Irish Lace," "Irish Crochet" "Chinese Irish and Filet Laces" and "Chinese and Irish Crochet" *The manufacturers* have been advertising the finished garment as "Trimmed with Irish Lace"

Against one such firm Bardwil Brothers, the Commission has issued the following restraining order

"It is ordered that the respondents Ameen Bardwil and George Bardwil, individually and as partners trading under the firm name and style of Bardwil Brothers the agents, *employees and servants of them, and each* of them, cease and desist from selling or offering for sale in commerce among the various States of the United States, as and for Irish lace or Irish crochet lace made in China or elsewhere than in Ireland, and from applying thereto or using in connection therewith, or as descriptive thereof the word 'Chinese' or any other geographical designation in conjunction or association with the word 'Irish,' or any *other name*, or *other* word, suggestive of Ireland as its place of manufacture"

Made in France

"BETSY ROSS, we are here," is a statement now in order for some Frenchman to make

American flags, it seems, have been imported in large quantities from France recently, a fact which might not have been called to public attention, had not the importers failed to comply with the law requiring that imported goods be stamped with the name of the country of origin Three consignments recently were held up at the Custom House at New York

The importers protested that the flags cannot be marked, stamped, branded or labeled without injury Judge Adamson, of the Board of General Appraisers, however, ruled that they must be, and that the Collector of Customs was justified in imposing an additional duty of 10 percent *ad valorem* because they were not legally marked.

Hereafter, therefore, do not be surprised to see on an American flag the label: "Made in France."

Patents Recently Issued

Classified Advertising

Advertisements in this section listed under proper classifications, rate 25c per word each insertion, minimum number of words per insertion 24, maximum 60. Payments must accompany each insertion

Official copies of any patents listed in this section at 15c each, state patent number to insure receipt of desired patent copy

Pertaining to Apparel

GARMENT—In the form of a slip' which will be more graceful, especially on stout figures, and will better accommodate a sitting posture Patent 1580208 Sully C Rood, 861 Sutter Ave, San Francisco, Calif

PRINCESS SLIP—Which will fit the figure *snugly, especially across the chest and back* and be readily adjustable to different sized figures Patent 1588357 A Gullts, 543 W 140th St New York, N Y

HEADDRESS—Adapted for persons having bobbed hair a comb being so constructed that suitable ornaments or a cap may be associated therewith Patent 1589185 R W Lithgow, c/o Los Angeles Country Club Beverly Hills, Calif

Electrical Devices

TELEPHONE RECEIVER PROTECTOR—Comprising a cup-shaped member formed of paper to be placed over the receiver for preventing the transmission of contagious diseases Patent 1589130 T A Dominguez, c/o J A Dominguez & Son Mayaguez Porto Rico

TELEPHONE ATTACHMENT—For preventing fraudulent or lightweight coins from operating the signal gongs of pay station telephones Patent 1587400 J E Wyckoff c/o Rochester Telephone Corp, Rochester, N Y

COUPLER FOR RADIO—Which in its operation permits finer tuning and more stable operation and reduces the cost Patent 1587381 A P Hinsky c/o E A Weeks, 8428 114th St, Richmond Hill N Y

PIANO LAMP—Particularly designed for detachable association with the cross rail of grand pianos and extending forward of the music rack. Patent 1587388 J Lieberman 39 W 22d St., Bayonne, N J

CONDENSER—Wherein one set of rotors enters the stator plates while the other leaves, with means for adjusting either of both rotors Patent 1587389 O G Linsen 151 Highland Ave, Jersey City, N J

SWITCH THROWING DEVICE—An arrangement of electromagnets and levers especially designed for use in connection with toy rail roads or railroads of any type Patent 1588306 H A Heyne 8080 213th St Queens Village L I, N Y

ELECTRODE CONSTRUCTION—For lighting and heating purposes whereby the electrodes burn more uniformly and the arc requires no controlling mechanism Patent 1590068 E Dobrowsky, 168 W 96th St., New York, N Y

STORAGE BATTERY—With means for sealing the battery against loss of fluid at points where the terminals project for use on automobiles Patent 1588959 E Gregg, c/o L S Robson, Claremore, Okla

STORAGE BATTERY CONSTRUCTION—Which will prevent corroding of positive terminals, the breaking of jars, leaking of the electrolyte, and the soaking of the wood case Patent 1588502 A M Small, 2501 Central Ave, Middletown, Ohio

Of Interest to Farmers

THINNING OUT AND WEEDING MACHINE—Wherein a number of blades give clean cuts through the earth, and vegetables or weeds, so that the action will also cultivate Patent 1588300. A Christensen and A W Warren, c/o A. W. Warren, 50 Ashford St., Hartford, Conn.

TRACTOR AND GUIDE—Whereby the plow may be shifted easily in a transverse direction to the direction of the tractor movement. Patent 1588273 G H Scanlan c/o J A Sheehan, 14 Court St Brooklyn, N Y

SOIL SCREEN FOR PLOWS—An attachment upon which the furrows can be turn[ed] directly resulting in the separation of weeds [e]tc from the soil Patent 1590015 J Kemp Box 8, Dublin N D

COMBINATION MIDDLEBREAKER AND CULTIVATOR ATTACHMENT FOR PLANTERS OR FERTILIZER DISTRIBUTORS—Which can be attached to and removed from the side bars of an ordinary planter without special tools Patent 1588400 J B Drew Hollandale Mississippi

PNEUMATIC DRAFT GEAR FOR THE CULTIVATING TINES OF STUMP JUMP AGRICULTURAL IMPLEMENTS—Giving an easier adjustment of the pressure on the tines to meet varying conditions of ground or tilling requirements Patent 1589115 W A Coombs c/o Collison & Co 483 Collins St Melbourne Australia

Of General Interest

CATAPULT—For the projection of arrows *and similar projectiles whereby the full im*pelling force can be utilized and accurate aiming facilitated Patent 1581026 W L Barth 816 Woodlawn Ave Venice Cal

EXTENSIBLE MAST AND SUPPORTING MEANS THEREFOR—Durable and light weight, may be secured to a gable roof to act as a support for radio antenna or the like Patent 1581325 R J Sands, 288 Oak Knoll Ave Pasadena, Cal

MEANS FOR FORMING SEPTIC TANKS—Whereby the walls of tanks of different sizes and shapes may be accurately formed from material in a plastic state Patent 1582271 J Johnson 203 E Buffalo, Tampa Fla

STEAM TRAP—For the purpose of automatically effecting the removal of condensate or the water of condensation from steam systems Patent 1582750 W H Hodgkiss 154 Oxford St Brooklyn, N Y

BURGLAR ALARM—A spring actuated cartridge firing bolt applicable to doors or windows the cartridge being fired on the opening of the door or window Patent 1583870. F A Reece and L T Coventry 2222 Railroad Ave Aberdeen Wash

TOOTH CLEANER—For effectively removing foreign substances from the crevices at the same time polishing and cleaning the teeth Patent 1581501 A F Wright, 500 Almer Road Burlingame Calif

PALM GRIP—A device to be worn on the hand by *handlers of sacks and similar con*tainers of grain Patent 1583006 W H Roussel, 152 Clay St San Francisco Calif

SLIP CONSTRUCTION—Whereby boats may be warped into the slip without causing any damage to the walls of the slip Patent 1583638 Y O Zadigian 408 Hudson Ave West New York N J

COLLAPSIBLE SLED—Including a plurality of longitudinal telescopic sections which admits of materially reducing the sled length Patent 1583003 L Krafft 213 E 60th St. New York N Y

GATE—Normally closed yet may be actuated by the weight of an approaching vehicle or traveler to open position Patent 1588869 F H Hover, Box 127 De Quincy, La.

FISH LURE—Which will spin in the water, without any "churning" action, par-

Uncle Sam's Patent Rights

THE House of Representatives' Committee of Inquiry into the operations of the United States Air Services found it necessary to study the question of patents Here is what they reported

"There are many instances in which it is necessary or desirable that the Government acquire the use or ownership of patents for aircraft or other requirements The Government is frequently charged with the infringement of patent rights by owners The Government may acquire a patent or the right to use it by purchase or by appropriation

In practice the methods of acquiring patents both by purchase and appropriation do not appear satisfactory either from the standpoint of the Government or the patentees If the Government infringes or appropriates a patent the only recourse of its owner is to prosecute a suit in the Court of Claims The expense and delay of such a proceeding frequently amounts to a substantial denial of the rights of the patentee

Trademarks and Health Authorities

IN Havana the Department of Health has established a special bureau under the supervision of Colonel Doctor Muxo for investigating dealers who falsely label products of real or pretended foreign origin Where evidence warrants it police raids are made

In the first police raid a large variety of commodities was seized among them being a patent medicine for rheumatism said to be made in New York canned pears marked Zoila' purporting to come from San Francisco *and canned asparagus also said to* come from San Francisco

The campaign will be prosecuted vigorously While the majority of the fake products thus far seized are medicines foods and liquors of pretended Spanish and French origin many of the items are represented as imported from the United States

American Label Men Score

THE recent decision of the United States Customs Court upholding the collector's assessment of duty at the rate of 60 percent *ad valorem* on woven labels imported by the Pitts and Kitts Manufacturing Company as manufacturers of silk is a distinct victory for American label makers The decision was made over the importers protest that they should have been taxed at only 55 per cent as silk fabrics with fast edges

Woven labels such as are affixed to clothing are made in large pieces and then cut Label men in this country do a business of about \$6 000 000 annually Their expenses are somewhat heavy with weavers being paid from 40 to 60 dollars a week on a piecework basis In European countries similar workers receive less than 9 dollars a week Consequently when German firms solicited orders all over this country some time ago American label makers went into a fight that threatened their very existence

Another victory not mentioned in the decision is that having to do with the provision of the law which requires that imported labels be marked to show the country of origin The ruling first was made that only the container of the labels be marked with the country in which the labels were manufactured The American label manufacturers contended that woven labels should be treated the same as cigar labels namely, that each individual label state the country of origin They won their point on appeal

The American label manufacturers are not freed of foreign competition yet, but these two victories help.

ticularly attractive and not likely to get out of order Patent 1584100 F L Koepke Box 18 Ridgefield Wash

MOSQUITO NET Which without discomfort will fully protect the head face and neck or may be partially opened to expose the eyes and mouth Patent 1583872 D W Davis c/o G D Anderson, Keith Bldg Beaumont Texas

INDEXING DEVICE—Whereby a card may be picked out of a series, by the initials of the given and middle names Patent 1584-548 A Menger 611 Adams St San Antonio, Texas

FOUNTAIN SHOE POLISH DAUBER—Adapted to be used to apply polish to a shoe without causing the hands of the user to be soiled Patent 1584566 R Lapurre Whipple, Arizona

MEANS FOR TEACHING READING—By inculcating the association of the first letter of the name of an object and a graphic representation of the object itself Patent 1584627 R T Marino Carrera 4a No 140 Bogota, Colombia

SPRING SEAT—Having a frame in which the forward portion is adapted to move more readily than the rear portion thus evenly distributing the weight Patent 1584577 A Wickman 218 Harrison Ave Harrison, N Y

DINNER PAIL—Wherein different articles of food may be stored maintained at a warm temperature and the contamination of the food prevented in transport Patent 1582938 J P Lopez and W L Ward, 1720 Bellevue Ave Los Angeles Calif

SUPPORT FOR WORK MAGNIFYING LENSES—For working on fine objects, where both hands of the operator are required, and the use of a magnifying lens is necessary Patent 1584519 A M Drits 258 5th Ave New York, N Y

COMBINATION FORK AND TRAY—Which allows a complete pre arranged layer of eggs to be lifted as a unit and transferred to a processing machine Patent 1582837 A F Lindstrom, 184 6th St, San Francisco Calif

INCUBATOR—In which pure heated air is automatically kept in circulation through the sections containing the eggs and the foul air expelled Patent 1584154 H H Treffer 119½ E 2nd St Davenport Iowa

WINDOW BOX—Adapted to hold foods and arranged to be disposed against a lower sash, and that fresh air may circulate through the box Patent 1585592 M I McArthur, 519 Tucerne Ave Lake Worth Fla

TABLE—Of the folding type, with simple and quickly adjustable bracing means for holding the supporting members in rigid position Patent 1585598 C N Miner Concord, Mass

SANITARY CABINET—Having means for movably supporting a receptacle from which lard or any other substance may be dispensed Patent 1585574 J H Thompson and J W Carter, c/o J W Holman Fayetteville, Tenn

COMFORT CHAIR FOR CHILDREN AND INVALIDS—Having independently adjustable back and seat portions easily manipulated according to the growth of the child or condition of the invalid Patent 1585545 R Ingham, 8 Hopkins St Nashua N H

PISTON ACTUATOR FOR GREASE COMPRESSORS—Wherein an adjustable tension device is provided acting to cause the continuous pressure of grease thereby eliminating all air bubbles Patent 1585538 G W DeLoach, 90 South Robert Blvd Dayton Ohio

FISH NET—Having a plurality of pockets so constructed that they permit entry but prevent the escape of the fish Patent 1585483 C K Freer c/o Hotel Myers Janesville Wis

EMBEDDED INKSTAND—For carrying removable ink wells and supporting pencils and other articles below the surface of the desk Patent 1585029 W T Guth 149 Van Dyke St, Brooklyn, N Y

TOILET ARTICLE—Comprising a mirror a comb and case and a spring clip for releasably supporting the comb and mirror Patent 1584858 F Hodaly Inspiration Arizona

BOOKMARK AND LEAF CLAMP Intended to hold the pages of a book from turning over, while the book is open to a desired page Patent 1585037 M J Kaslan, 4250 N Keeler Ave, Chicago, Ill.

MULTIFOCAL GLASSES—So constructed that any one of a plurality of lenses may be brought into position, by the manipulation of a single element Patent 1585489 H V Hallman, Box 509, Hartshorn Okla.

TOOTHBRUSH COVER DEVICE—Whereby the brush can be carried in a suitcase in proximity to other articles without any moisture damaging such articles Patent 1586488 R F Tollner, 723 W 14th St., New York N Y

FULCRUM DEVICE FOR EARTHWORKING IMPLEMENTS—Adapted to be attached to the leg and provide a fulcrum for manually rocking the handle shank of a shovel or fork Patent 1586181 S Rubio 920 Sunset Blvd, Los Angeles, Calif

SUPPORT SERVING AS CORE FOR BEADS DURING THEIR MANUFACTURE—Comprising a thin copper tube and a solid wire disposed within the wire being removable from the beads and the tube easily dissolved Patent 1586462 J Paisseau c/o C Iliery 2 Boulevard de Strasbourg, Paris, France.

NAIL FILE—The cutting portion of which stops in front of a smooth edge so that the skin next the nail will not be injured Patent 1586441 J A Blom S W 48, Wilhelmstrasse 8, Berlin, Germany

BASEBOARD AND SHOE MOLD—With beveled surfaces which form a tight joint taking from the room only the space formerly occupied by the baseboard Patent 1585900 I A Baum c/o Stickley & Fitzhugh, 1010 Fidelity Bldg Memphis, Tenn

MOISTUREPROOF SCRIBABLE SHEET TAG AND THE LIKE—Formed with a base of a given material and covered with a substance readily penetrated with a stylus Patent 1586433 C T Wittstein, Warren and Arch Sts Newark N J

BAG AND HARNESS THEREFOR. Especially adapted for use by school children and girl and boy scouts constructed to keep the shoulders back and head erect Patent 1586058 R M Winfield, Fort Davis Canal Zone

NEEDLE THREADER By means of which an ordinary sewing needle may be threaded with ease even by one whose eyesight is poor Patent 1585883 A Stephen 165 W Ohio St Chicago Ill

CORNER BUILDING BLOCK—Designed to provide end grooves to facilitate handling and to serve as a passageway for reinforcing elements Patent 1587482 G Fy North 4th St Woodside N Y

BELT LIFE GUARD—Easily applied to or removed from a window frame, allowing free movement yet guarding persons cleaning the outsides of windows Patent 1587478 G Dignovanni 400 F 171st St, New York, N Y

LAMP BASE OR PEDESTAL—Which includes a skeleton framework and a translucent covering permitting the matching of the pedestal and lamp shade Patent 1587469 R I Campagna 1802 Kings Highway Brooklyn N Y

COATED BUTTER In which the coating is unnoticeable edible will hold the butter in shape and prevent it from absorbing odors Patent 1587414 W H Pond, 124 Goodrich St, Astoria L I N Y

CIGARETTE CASE—Which may be inexpensively produced and is provided with means for projecting the cigarettes for easy removal Patent 1586248 M Komura 1639 Post St San Francisco Calif

MOP HEAD Whereby a mop may be secured in such manner as to facilitate the wringing thereof yet may be easily removed Patent 1587376 T H Gillis, Commerce Hotel Gainesville Texas

FINGER RING—Which may be quickly adjusted to move a reflecting member to be visible through an opening in the rings outer wall Patent 1586606 I L Cain, Box 1578 Wichita Falls Texas

INDEX—In the form of a turnable structure, with the indexes disposed about an axis and capable of being slid laterally outward Patent 1588209 A Boucher 50 Commonwealth Ave Dedham, Mass

SERVICE PIPE BOX AND CUT OFF—For the supply of water or gas, constructed with an outer and inner casing effectively sealed and having coacting means. Patent 1588371 H S Isham 404 10th Ave Belmar, N J

PROCESS OF PRODUCING REPLICAS OF TEXTILE SAMPLES—By the use of yielding blanks capable of receiving impressions and of being cured or vulcanized to set the impressions Patent 1586278 B F Stas, c/o Munn, Anderson & Munn, Woolworth Bldg, New York, N Y.

AUTOMATIC FEEDER.—In which stock can not interfere with the operation of the device, and feed is admitted to the trough, only as required Patent 1587775 T J Higgins, Odell, Ill

READY MADE DUMMY TOOTH—To be used as a bridge between two abutting teeth, and may be readily anchored without the anchoring means being exposed Patent 1580912 H E Murphy, 615 Miner Bldg, Eugene, Oregon

Hardware and Tools

LOCK NUT—Made in sections with wedge means to tightly bind the sections on the bolt to prevent displacement. Patent 1585,627 D O Brien, Punta San Juan, Cuba.

PERMUTATION LOCK—Which is absolutely noiseless so that it would be impossible for unauthorized persons to open the combination by sound Patent 1584834 C F Blacks, 610 W 5th St., Topeka, Kansas

WORK HOLDING CLAMP—Having a minimum number of adjustment screws for holding work in numerous positions and at convenient angles to the operator Patent 1586490 A S Hainsworth, Box 5, West Pittsburg, Lawrence County, Pa

FAUCET—Of the automatic closing type operated by pressure which functions to admit fluid gradually to the nozzle and will prevent freezing Patent 1586418 J Frederiksen and C Sutherland, Bend, Oregon

AUTOMATIC AND ADJUSTABLE BURETTE AND FUNNEL HOLDER.—Formed from a single length of spring wire thereby exposing the reading thereon throughout the full length Patent 1585959 W S Avery c/o Chas O Hill, 1835 Melrose Ave, Knoxville Tenn

ATTACHMENT FOR SHOVELS—Allowing the utmost freedom in manipulating the shovel without necessitating the operator bending over as much as usual Patent 1586056 A Q Walsh Hartsdale, N Y

FELT CUTTING TOOL—By means of which a washer or gasket of any size or shape may be quickly cut Patent 1586267 C J Rector, Box 545 Monterey Calif

KNIFE OR CLEAVER—Wherein the blade is detachably mounted yet securely held in the handle so as to be reliably safe in operation Patent 1586906 I Lewis, 425 So 16th St Terre Haute Ind

CENTER PUNCH—For facilitating the operation of definitely locating the central or axial line of machinery shafting or the like Patent 1586281 G A Brunelle, c/o French Hospital Geary St and 6th Ave San Francisco Calif

CAN OPENER—Where both hands of the operator are used to manipulate the blades bringing more power and greater speed on the operation Patent 1586264 A Page, 1700 La Loma Ave, Berkeley, Calif

RAZOR BLADE KNIFE—Which will firmly hold a safety razor blade permitting its use as a knife or for the honing of the blade Patent 1587358 F F Arnold and C Kastel, 206 E 19th St New York, N Y

WRENCH—A self adjusting wrench which is particularly designed for use in connection with small sizes of bolts or taps Patent 1587407 J D O Brien, 2 Burling Slip, New York, N Y

SYSTEM OF PADLOCKS—Especially planned for gates in the country with the purpose of inducing those who pass, leaving the gate shut behind them Patent 1587482 J Sirven c/o G Brouer, Maipu 671, Buenos Aires, Argentina

LINE AND SURFACE LEVEL.—Having means whereby it is locked against accidental disengagement on a line, and on the surface gives true results Patent 1587436 E A Stevens, Newton Falls, Ohio

GUIDE FOR SASH WEIGHTS—Consisting of metal plates, operable to constrain the weights in a smooth manner and to prevent jamming Patent 1587218 W E De Camp, 420 W Adams St, Macomb, Ill

COMBINATION AX AND ADZ.—Having a head adjustable at will, so that the working angle may be varied and firmly secured to the handle. Patent 1587767 J. A Fatica, 71 Vine St, Willoughby, Ohio

LOGGING HOOK.—Having an independent latch which is movable into engagement with the ferrule on the free end of the choker Patent 1587678. W. Remington, 411 Water St, South Bend, Wash

CLAMP—For connecting the ends of a belt so that it may be kept taut, without projecting elements contacting with a pulley Patent 1588399 W. E Horner, c/o J H Bartlett, Atty, Tonkawa, Oklahoma.

SCREW THREADED JOINT—Adapted to be utilized for connecting tubular sections or stems used in connection with drilling or maintaining oil wells Patent 1588128. G A Montgomery, Box 625, Titusville, Pa.

SHEARS—Which will be rugged and durable in use, and will sever the relatively thick stems of a hedge by a clean cut. Patent 1590075 P Brenner, c/o C. Wagner, 242 Broadway, Monticello, N Y.

ROTARY REAMER—Which may be effectively utilized without wrenching or twisting the drill stem, and may be easily withdrawn from a well Patent 1589508. A Boynton, c/o Frontier Oil Co, Oil City Natl. Bank Bldg, San Antonio, Texas.

BALANCE LEVEL.—For carpenters and other workers, whereby not only the horizontal and vertical may be ascertained but substantially any angle from a horizontal Patent 1590136 W A Valentine, Sr, 46 New St, East Orange, N J.

WRENCH—Having a pair of pivoted jaws substantially in line with the handle, for turning an object in a relatively slight area Patent 1589206 G H Miller, R. F. D No 1, Monticello Maine

CLOSURE LOCKING DEVICE.—Capable of attachment respectively to a support and a closure, and coacting to prevent the movement of the closure Patent 1589149 F L Hanlo, 43 Morgan Place, Kearny, N J

GAUGE FOR CUT OFF SAW BENCHES.—Wherein the gauge elements are automatically shiftable to an inactive or active position when the gauged object is removed Patent 1589276 F H Weeks, 701 E Market St, Akron, Ohio

HANGER.—Shaped to be embedded in concrete, for securing pipes or the like to a ceiling, the supporting means being removably associated Patent 1588628 D S Sellers Jonquin Apt, 2209 E. 10th St, Indianapolis, Ind

Heating and Lighting

HEATING APPARATUS—Which combines in one structure the artistic features of the open fireplace, and the utilitarian value of the modern hot air heating plant Patent 1588587 C B Klaus, 3244 W 64th St, Seattle, Wash

FIREPLACE.—So constructed that air from the room and outside atmosphere is continuously circulated through the fireplace and heated during transit Patent 1587227 W Hallberg, 121½ So Plymouth St, Los Angeles, Calif

Machines and Mechanical Devices

BELT SHIFTER.—Having adjustable means for shifting a belt from a fast pulley to a loose one and for preventing accidental displacement. Patent 1582731 J B. Chace, 180 Stafford Rd Tiverton, R I

REFRIGERATED BUTTER CUTTING MACHINE. For cutting uniform blocks or pats of butter from a large bar, and further serves as a means for storing a supply Patent 1583637 R Wilson, 341 W 22nd St., New York, N. Y.

ROLLER IRON—Whereby the ironing of flat pieces can be quickly accomplished, the entire width of a piece being pressed by a single stroke Patent 1582379 E D Campbell, 675 19th Ave, San Francisco, Calif.

PICTURE EXHIBITOR—For exhibiting so-called motion pictures and advertisements in daylight, and without the use of artificial light Patent 1581460 C H. Mc Cadis, 388 12th St, Oakland, Calif.

AUTOMATIC ELEVATOR GATE.—Actuated by the ascent and descent of the elevator, the gate opening and closing as the elevator approaches or leaves a floor Patent 1581,-477. W. H. Shafer, 523 14th St, Sacramento, Calif

FUR-SHEARING MACHINE.—Especially designed for clipping to a uniform length the fur of fur bearing pelts or hides. Patent 1583675 M Dickerson, c/o Gilroy & Hyman, Room 2024, Woolworth Bldg, New York, N. Y

GOVERNOR.—For the spring motors of talking machines, which reduces the pos-

ability of breakage to a minimum. Patent 1589640. J. Zitserman, 449 Stone Ave., Brooklyn, N. Y.

CREAM-WHIPPING DEVICE.—Which is power driven and in which the whipping or beating member may be easily removed without the use of tools. Patent 1584562. C. A. Kulenkampff, 123 White St., New York, N. Y.

DIPPER.—In which the bottom is swingable from closed to open position to allow the body to pass through liquid without disturbance. Patent 1584558. E. Krafft, 213 E. 60th St., New York, N Y

SEPARATOR.—With means for removing, by centrifugal force, the particles collected from gases without allowing the escape of the gases. Patent 1584635 W. F. Nagel, 2643 Pike Ave., Ensley, Ala.

SIPHON PUMP.—So constructed that the siphonic flow of a liquid from a receptacle can be broken and renewed at will. Patent 1582390. V W. Helander, 403 N Center St., San Pedro, Calif

MITERING MACHINE.—By means of which a conventional hand saw is supported so that joints of any desired angle may be accurately cut. Patent 1582396. F Hanemann, 1070b Linden Ave, Glendale, Calif.

FAN.—Of simple and durable construction whereby the blades may be adjusted vertically and secured in adjusted position Patent 1588864. A. W Tucker, c/o St. Anthony Hotel, San Antonio, Texas.

KIER SOLUTION CONTROLLER.—Whereby liquid is blown through the cloth in the bottom of the kier, and the solution does not come in contact with the air Patent 1584401. A F Taylor, 425 First St., Kannapolis, N. C.

TIDAL CONDUIT SYSTEM FOR SEWERAGE.—Wherein means are provided for collecting sewerage and then automatically discharging the same into the ocean on an outgoing tide. Patent 1584666. H G Shockley, 10 Woodbridge Place, West New Brighton, S. I., N. Y.

WASHING MACHINE.—Which has in combination a chute and safety guard allowing the introduction of cleaning solutions without injury to the operators. Patent 1585,-565. J. H Siemann, 283 11th St., Brooklyn, N. Y

COMBINED ROAD DRAG AND SCARIFIER.—Which is adjustable, made entirely of metal, and by means of which roads may be surfaced and leveled at a minimum cost. Patent 1585044 W J Patton, c/o Central States Steel Co., Frisco Bldg, St. Louis, Mo

LAUNDRY MACHINE.—Having special mechanism for moving the containers through the rotor, in which the clothes of various families can be washed independently of each other, thus obviating the marking of the clothes, seven of the machines handling the various types of washing done by the standard laundries. The inventor has been granted three patents 1584769, 1584,-770, and 1584771. E. L. Hurd, c/o White Swan Laundry, 15 Broadway Circle, Oklahoma City, Oklahoma.

ROTARY DISPLAY RACK.—Which allows a plurality of sheets of wall paper, linoleum, and the like, to be successively displayed by mechanical means, not requiring an operator Patent 1583158. R. F Johnson, Wenatchee, Wash

FUR BRUSHING, STRAIGHTENING AND BEATING MACHINE.—First causing the hair to be straightened out, and finally beaten to raise the hair on the skin. Patent 1586,-420. S Friedman, c/o Reliable Machine Works, 239 Eagle St., Brooklyn, N Y

APPARATUS FOR LOADING MATERIAL.—By means of which coal or other material may be continuously discharged into each car of a train Patent 1585604. F L. Schoew, 1439 5th Ave., Huntington, W. Va.

NONCOLLAPSIBLE FLOAT FOR LIQUID-LEVEL CONTROLS.—Which may be employed in containers in which a pressure is used which is greater than atmospheric pressure. Patent 1586476. E. E. Simpson, c/o Humphrey & Campbell, Roberts Bldg., Tulsa, Okla.

WAVE MOTOR.—Which affords facilities for making use of the power of incoming waves for operating an air compressor or like mechanism. Patent 1586492. C. Venter, 1928 Lawrence St., Denver, Colo.

PORTABLE COAL TIPPLE.—Whereby the coal is graded at the place where it is mined and directly loaded into the cars utilized for shipment. Patent 1586022. G. C. Singer, Oakland City, Ind.

TIME INDICATING DEVICE.—For determining time with the usual clock dial and hands, by means of an actuating device operable according to the position of the sun. Patent 1587418. J. Pond, Box 100, Summerside, Prince Edward Island, Canada.

PAINT-MIXING MACHINE.—In which the receptacle and the mixing element cooperating therewith are rotated in opposite directions, and secured against displacement. Patent 1588338. A. F Purner, 523 Hoboken Road, Carlstadt, N. J

CONNECTING ROD.—For connection with a piston in such manner that a universal connection is established. Patent 1588137. C. A. Myers, 602 Arlington St., Tamaqua, Pa.

DITCHING MACHINE.—Which may be pulled by draft animals or a tractor without requiring the operator's attention in steering the machine. Patent 1586940 J S. Blackie, Marysville, Calif

POWER TRANSMISSION DEVICE.—For transmitting power from the rear wheel of a motor vehicle to a shaft, for the actuation of stationary machinery Patent 1587778. W H. Kadesch, 1109 Main St., Cedar Falls, Iowa.

COMBINED DOT AND FLAT CLOTH PRINTING MACHINE.—Wherein the flat printing is first performed, and then the dots are placed on the fabric by flocking in any desired succession Patent 1588318. L. L. De Smet, 250 Van Houton St., Paterson, N. J.

BELT TIGHTENER AND COUPLER.—Which will afford facilities for drawing the ends of a belt together for coupling the same, while trained about pulleys. Patent 1588,-368. W E. Horner, c/o J H. Bartlett, Atty, Tonkawa, Okla.

ADJUSTABLE STOP FOR LEVERS ON EDGERS.—Of such construction that relative adjustments are readily made to suit the various throws of the operating lever of a saw mill edger Patent 1589107 J F McCarroll, c/o Standard Machine Co., Baton Rouge, La

Musical Devices

CLARINET.—Having an arrangement of keys and an operating mechanism whereby the fingering is done without shifting the hands when once positioned. Patent 1585,-504 J D Mackey, c/o Mountain State Engraving Co, 1025 Swan St, Parkersburg, W Va.

SNARE-WEAR-RELIEVING DEVICE.—For relieving the wear on the skin head of a drum, especially where the snares pass over the edge Patent 1588324 G Martens, 3541 35th St., Jackson Heights, Elmhurst, N Y.

MUSICAL INSTRUMENT.—Having strings so arranged that they will produce normally all the notes of a musical composition in a restrictive zone Patent 1588830. J J. Westbrook, Jr, Box 724, Danville, Va.

Prime Movers and Their Accessories

CHARGE FORMING DEVICE.—Designed to make it practicable to use crude oil as a fuel for the engines of conventional types of tractors. Patent 1587423. B J Rybin, c/o C. J Baldwin, Bridger, Mont

APPARATUS FOR INDICATING THE CYCLES OF INTERNAL-COMBUSTION ENGINES.—For instructing a motorist the various cycles of the different pistons, and the positions of the intake and exhaust valves of an engine Patent 1589111 A. J Carr, Box 772, Balboa, Canal Zone.

Railways and Their Accessories

AUTOMATIC RETAINING VALVE FOR AIR BRAKES.—Which permits the air from the cylinder to exhaust slowly, thus keeping the brakes partially applied while the cylinders are recharged with air Patent 1586801 J L. Farmer, 1811 Jackson Blvd., Chicago, Ill.

RAIL LUBRICATOR.—By means of which a lubricant may be rapidly applied to a rail and be constantly stirred during the feeding. Patent 1590078. G. Buros, c/o F Caracciolo, P O. Box 55, Caracas, Venezuela.

Pertaining to Recreation

PURSUIT TOY.—Wherein a figure in the form of a policeman is represented as pursuing a second figure in the form of a fugitive. Patent 1586143. J. A. Ross, 147 Prospect St., Nanticoke, Pa.

CHILD'S VEHICLE.—Which may be propelled by the feet, and has a rocking seat operable during the movement of the vehicle Patent 1587030. P. P. Wetzel, Basic, Waynesboro, Va.

GAME.—Played on a board with marbles, amusing, providing educational value, and developing ability in arithmetic Patent 1588760. H N Massey, 2010 Melvia St., Berkeley, Calif

Pertaining to Vehicles

AUDIBLE OIL ALARM.—Device for giving an audible alarm when oil pressure in motor drops below a certain fixed point, of simple and sturdy construction with no moving parts. Patent 1582154 Zeller Bros., Kemmerer, Wyo.

SINGLE FOOT PEDAL FOR AUTOMOBILES.—Which controls the clutch, brake arms, and accelerator, and permits effective control by an operator with a single limb. Patent 1584712. A L. Bailey and R. R. Gatzke, Box 1010, Butte, Montana

RADIO CAP.—A closure which can be readily expanded into a funnel, thus functioning as two different devices. Patent 1583153. F S Holtz, Box 83, Berkeley, Calif

ADJUSTABLE PRESSURE FEED AND EQUALIZING CHUCK FOR INFLATING HOSE.—Having means for supplying pressure to a tire up to a certain point, or bringing the pressure down in case of over inflation Patent 1584934 W A Harris, 238 John St., Greenville, S. C

LUBRICANT DISTRIBUTOR.—Operable from the driver's seat, for lubricating all the bearings of the chassis simultaneously, proportionate to their individual needs. Patent 1585186. C C Crispen, 708 17th St. Harrisburg, Pa

ENGINE-FLUSHING DEVICE.—For effecting the removal of carbon from the cylinders and valves of motor vehicle engines. Patent 1585025 B Gorschalki and L I Riggin, 870 Morengo Ave, Pasadena, Calif

NUMBER PLATE BRACKET.—Which affords facilities for holding releasably, a number plate of any desirable size, and supporting one or more lights. Patent 1586408. C Champoux, c/o F G Karssmann, Lawrence, Mass.

BLOW OUT PATCH.—Adapted to co-act with the valve stem of an inner tube and hold the same in proper position on the tire Patent 1586104 O A Morehouse, Cameron, Mo

LUBRICATING SYSTEM FOR AUTOMOBILES AND OTHER MOTOR CARS.—Having means for lubricating various points from a central reservoir, and means for preventing the exhaustion of the lubricant Patent 1585710 I M Jackson, c/o Rope & Cordage Co., Union Trust Bldg, Parkersburg, W Va.

DIRIGIBLE HEADLIGHT FOR VEHICLES.—Adapted to automatically turn the head lights in the same direction as the wheels, and is also to swing in vertical plane Patent 1586045 J M Calkins, Box 611, Detroit, Mich

AUTO LICENSE PLATE HOLDER.—In which the plate may be quickly released, or attached, especially adapted for use by automobile dealers Patent 1586004 F Kuhn, P. O Box 83, Quincy, Ill

VULCANIZING BLOCK.—For repairs of inner tubes of pneumatic tires, adapted to cause a better flow of the repair gum Patent 1586275. P R. C. Winans, 1152 Locust St., Riverside, Calif

SEAT OPERATED AIR STORAGE AND BRAKE.—For motorcycles operated by the rider of the vehicle for transmitting the stored air to the brakes. Patent 1584058. R. Learmont, Box 9, Boorowa, New South Wales, Australia

ANTISKID DEVICE.—Which will permit the ready attachment of a chain to a shoe and the removal or replacement of a worn tread member Patent 1587313 S Hisanosuke, 120 W 123d St c/o Japanese Y M C A, New York, N Y

VEHICLE BODY.—Having means whereby the body of a motor vehicle may be completely closed when desired. Patent 1587000 J M. Jackson, c/o Rope & Cordage Co, Union Trust Bldg, Parkersburg, W Va.

FUEL TANK.—For conserving a definite quantity of fuel, and means for warning the operator as the supply decreases. Patent 1588124. P A. May, 616 4th Ave. East, Apt. E, Cedar Rapids, Iowa.

ADJUSTABLE PRESSURE AIR SERVICE APPARATUS.—For the power inflation of pneumatic tires, which will be continuously efficient and accurate with both low and high pressure Patent 1588107 W A Harris, c/o G & H Tire Chuck Gauge Co., Greenville, S C

WAGON CONSTRUCTION.—Having novel means for connecting with the king bolt, and for securely and rigidly fastening the hounds thereto Patent 1588323 F A. MacNab, Granby, Colo.

DISK CLUTCH.—For use in a clutch of the multiple disk type, admitting a very strong ventilation, resulting in better dissipation of the heat Patent 1588306 E. Buisson, c/o C Bletry, Aîné, 2 Boulevard de Strasbourg, Paris, France

AIR PRESSURE GAUGE.—For the valve stem used in connection with an automobile tire, applicable to and forming part of the valve stem Patent 1588285 E G Weaver, 110 So Idaho St, Butte Mont

CLUTCH FOR TRACTORS.—Wherein the parts may be actuated for turning the tractor without injury to themselves or any part of the structure Patent 1588272 G H Scanlan, c/o J A Sheehan, 41 Court St., Brooklyn, N Y

COIL-LOCATING GAUGE.—Adapted to be bolted on the fly wheel of a Ford engine, to engage the field coils for predeterminately positioning said coils Patent 1588101 R. A. Farnam, Box 808, La Grande, Ore

AIR-PRESSURE GAUGE.—Forming part of the valve stem of an automobile tire valve, and for indicating at all times the pressure Patent 1590141 E G Weaver, 621 N Main St., Butte, Mont.

AUTOMOBILE.—Having a combined running gear and steering mechanism in which a differential is replaced by clutches for connecting the rear wheels to the power driven axle Patent 1589393 O L. Howe, 240 Blaine St., Missoula, Mont.

END GATE.—For wagons, trucks, and the like, providing a grain tight closure for the rear of the wagon box Patent 1588493. C. Polson, Vermillion, Kans.

DIRIGIBLE LAMP.—Which eliminates all gears and ratchet devices, operates smoothly, is weather proof, and suitable for installation at any point. Patent 1588702 W A Cannon, P O Box 809 Sanford University, Calif

VEHICLE TIRE RIM.—Which may be readily collapsed so as to remove it from the tire, the operation being accomplished by a single tool Patent 1589105 E. Calusinski, 1083 Milwaukee Ave, Chicago, Ill

COMBINATION VACUUM TANK AND REGISTERING DEVICE.—Allowing gasoline to be fed in measured quantities, so that the operator can at all times tell how much has been used Patent 1589008 T T Givens, R. F D No 4, Box 91, Merced, Calif.

AUTOMOBILE ROAD MAP ROLL.—Especially designed to be removably secured to the wind shield of a touring car or the frame of a closed car Patent 1589136. W D Fall, 422 So Spencer, Indianapolis, Ind

Designs

DESIGN FOR LIGHTING AND FIXTURE BOX.—Patent 70191 M Schlipp, c/o Sterling Spinning & Stamping Works, 476 Broome St New York N Y

DESIGN FOR A WEDDING RING.—Patent 70209 J Berlinger, 100 Fulton St, New York, N Y

DESIGN FOR A MEDIUMISTIC BOARD.—Patent 70170 C Hidalgo and J L. Zuazua, Garland Bldg, Los Angeles, Calif

DESIGN FOR A SHOE.—Patent 70267 T Davis c/o Franklin Simon & Co, 38th St. and 5th Ave, New York, N Y

DESIGN FOR A BACKPLATE FOR LIGHTING FIXTURES.—Patent 70282 B Leshowitz, c/o Munn, Anderson & Munn, 24 W 40th St, New York

DESIGN FOR A COAT.—Patent 70318. T Davis, c/o Franklin Simon Co., 38th St. and 5th Ave, New York, N Y

DESIGN FOR A SHOE.—Patent 70310. T Davis, c/o Franklin Simon Co., 38th St. and 5th Ave, New York, N Y

DESIGN FOR A DOLL.—70315 D W Chandler, c/o Aunin & Co., 85 5th Ave., New York, N Y

DESIGN FOR A SHOE OR SIMILAR ARTICLE.—Patent 70360 T Davis, c/o Franklin Simon & Co., 38th St. & 5th Ave, New York, N Y

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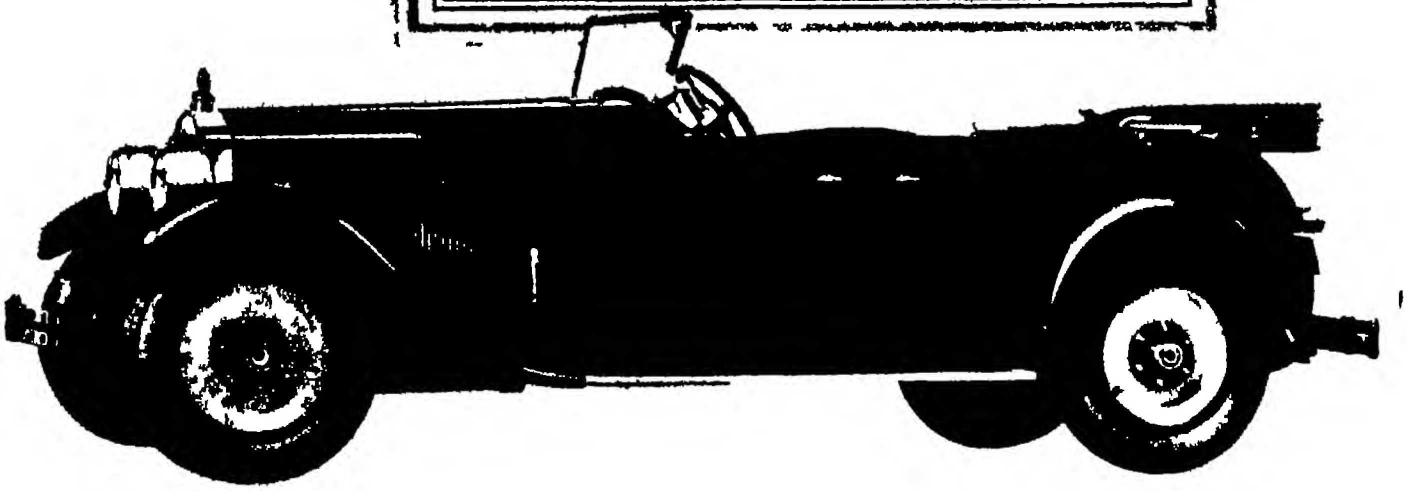

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When fam ne threatened Teheran the cap tal last w nter the Persian admin stration ordered ts first ten heavy duty trucks from the Internat onal Harvester organization Har ester world service placed the fleet at the nearest port on the Mediterranean Sea Be rut n Syr a ahead of other trucks or dered from Europe

Then began the test of truck qual ty a tr p of 1350 m les across trackless desert and over snow bound mounta ns On February 2 the avalcade set out The trucks chauffeured by Engl sh French Ital an Syrian Arabian and Druse were laden with food and fuel and w th tons of cement for the British at Bag dad and they were accompanied by an escort of armored cars of the Brit sh A r Forces

Twenty s x days were consumed between Beirut and Bagdad every truck axle deep in mud and sand practically every mile of the way Bagdad ancient city of romance gave the travelers a dinner in their honor and a night of rest and transferred them from des ert to mountain going Motor fuel for the Persian government and wheat took the place of cement for cargo The cavalcade forged on both night and day and entered Teheran the seventh day after Bagdad

The entire fleet was in the pink of condi tion and every truck of the ten on the morn ng of arrival went out to Kasvin a hundred miles away and began bringing back great loads of the precious wheat.

The Persian government impressed by the stamina of Internat onal Trucks im med ately ordered twenty more of them and these have since duplicated the travel history of the first fleet.

INTERNATIONAL HARVESTER COMPANY
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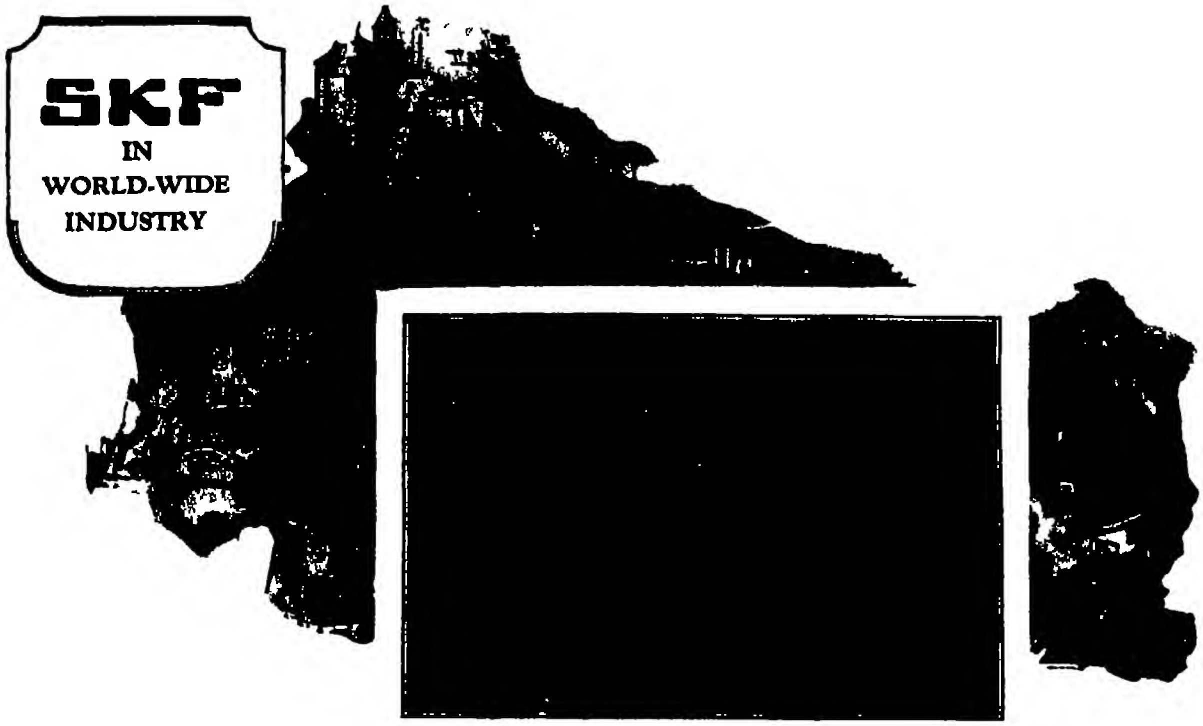
TRUCKS



Every Bite Sends Jarring Vibrations Thru the Bearings on This Loader

DOWN in the depths of the earth where the loader shown above is aiding a modern skyscraper gain its foothold, or on the intricate compass which guides the ocean greyhound as if by an invisible hand, SKF marked anti-friction bearings keep equipment going continuously and guard against costly bearing failures.

Into every SKF anti-friction bearing is built the stamina and endurance which foreshadows long-life service, even under the most arduous conditions. Wear is a negligible factor, thereby assuring the maintenance of precision clearances without the necessity of adjustments. It is these qualities which have made them first choice the world over where friction's costly toll must be slashed without sacrificing reliability.

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SCIENTIFIC AMERICAN

THE MAGAZINE OF TODAY AND TOMORROW

NEW YORK, OCTOBER, 1926 — *Edited by* ORSON D. MUNN — EIGHTY-SECOND YEAR

DEVOTION

IN this month's issue Professor Cockerell emphasizes the fact that everyone everywhere is eager to do a good turn for science. Often we have had occasion to note the same sort of enthusiasm. More than a year ago, in our issue of April, 1925, we broadcast an appeal for help in finding the lost fossil jawbone of a prehistoric man This had already been found seventy years ago, and lost again, possibly in some obscure corner of America A reply came from one of our readers, Mr W. F. Ollis of Mobile, Alabama, stating that the former owner of the fossil, a physician who died some years ago in New Orleans, was his uncle

At our request Mr Ollis journeyed to New Orleans, searched diligently for the scattered effects of his deceased uncle, visited places he had lived, the hospital where he died and the Tulane University Museum to which it was thought the doctor's scientific effects might have been sent Through his instrumentality the city of New Orleans was ransacked

The invaluable fossil was not found. It may be elsewhere

But Mr Ollis did his best, tramping over a great city in a torrid month. He journeyed in the name of science

EFFICIENCY

"THE fact has been determined by the Secretary of Agriculture that the contagious, communicable disease known as foot-and-mouth disease has been eradicated from and does not now exist in the United States"

Such is the opening paragraph of Secretary Jardine's order revoking a quarantine affecting certain areas in the State of California since February 23, 1924.

It is a good, clean-cut job of applied science; the Scientific American congratulates the men in the department for their efficiency

PROGRESS

THE *Antinoe* did not go down in vain.

Foundering at sea, the steamship *Antinoe* sent out an SOS call. The radio on the *Roosevelt* picked up the message and started for the stricken vessel. The latitude and longitude given in the call for help were wrong and the *Roosevelt* found itself a hundred miles out of the way. There was a radio compass aboard, however, and with its aid the storm-stricken vessel was found and the rescue completed.

Now the Bureau of Navigation reports that the radio compass, or direction finder for ships, has been installed on twenty-three vessels.

In This Issue

Fish That Carry Flashlights
Down in the cool depths of the sea there is no light—only inky, perpetual night. Yet fishes manage to live there and capture their prey. How? They carry headlights Science has learned some interesting things about these headlights. Commencing on page 247 some of them are told

How Did They Raise the S-51?
What were the facts? Couched in accurate engineering language by a naval engineer, this romantic struggle with the elements is narrated on page 257 by Lieutenant-Commander Edward Ellsberg. How he comes to *know* the facts is simple —he was in command of the job!

Are We Still in the Glacial Period?
Nobody knows "Come back in 100,000 years and find out"—this is the best answer science can offer The ice cap that covered continents long ago may return This is one of the legitimate sensations of science Few that have not read the article on page 272 are likely to realize how many glacial periods this ancient earth of ours has already experienced.

Man and the Insects at War
An all-devouring beetle threatens to spread across America Pending the discovery of a way to cope with it, government experts are penning it within the area of a few states How long can they keep it there? Will any of the eleven bugs that have been imported to prey on it be able to exterminate it? On page 276 the remarkable account of this new insect war is presented.

MORE THAN 200 PICTURES

Complete table of contents will be found on page 319

For Next Month

How Long Has Man Been in America?—A Controversy
In the issue of July a noted scientist, Dr Ales Hrdlicka, denied that the Indian had been in America long. But other scientists say otherwise—man was here when the glaciers were here, and perhaps before that. Next month we shall publish a rejoinder to the article which appeared in the July issue.

"Tin-clad Suicide Ships"
Thus does a noted naval critic characterize the new Washington Treaty cruisers that every nation is now building Costing \$10,000,000 apiece, he says they are simply speed machines, vulnerable to a degree unprecedented What shall we do about it? The next issue offers a solution

Radio 1926-27 Fashions
New radio styles which will be in vogue this winter will be described and illustrated in the November issue The article will include helpful information for broadcast listeners regarding battery eliminators and the possibilities of future development of current supply devices which dispense with batteries

Other articles on Navy Signaling, The Movement of Your Eyes When Reading, A Monster Storm Sewer, The Most Powerful Machine on Earth, Insect Classifications, Mortalities; Conservation; Radio, Astronomy

MORE THAN 200 PICTURES

BLUFF

THERE is no man living today who knows all, or even an appreciable part, of science One man can learn one branch of science fairly well, some sub-phase of that branch very well or nearly the whole field of science in a superficial manner

Today, frank admission of ignorance concerning a given matter in science is no disgrace The great Loeb, biologist of world fame, while teaching a class in embryology early in his career, was asked a question His reply was, "My dear young lady, I cannot answer your question, because I have not yet read that chapter of the textbook myself, but if you will come to me tomorrow, I shall then have read it, and I may be able to answer you"

Yet Loeb was one of the world's greatest scientists. He wasn't afraid to say, "I don't know"

FAKERS

HAVE you had your radium today? This seems to be the thought that many drug and "health water" manufacturers are trying to put over The amount of radium contained in the various substances that are being vended as having curative properties due to their radium content has been investigated by the Bureau of Chemistry of the United States Department of Agriculture. The findings have been that only 5 percent of the products analyzed contain radium

Even though many of the medical products that are advertised to contain radium do not have such material in their make up, a warning should be sounded against the use, by the inexperienced person, of any curative medium that *does* contain radium

"Radium in active dosage," says the Department of Agriculture, "is potent for harm as well as for good and should be administered with caution"

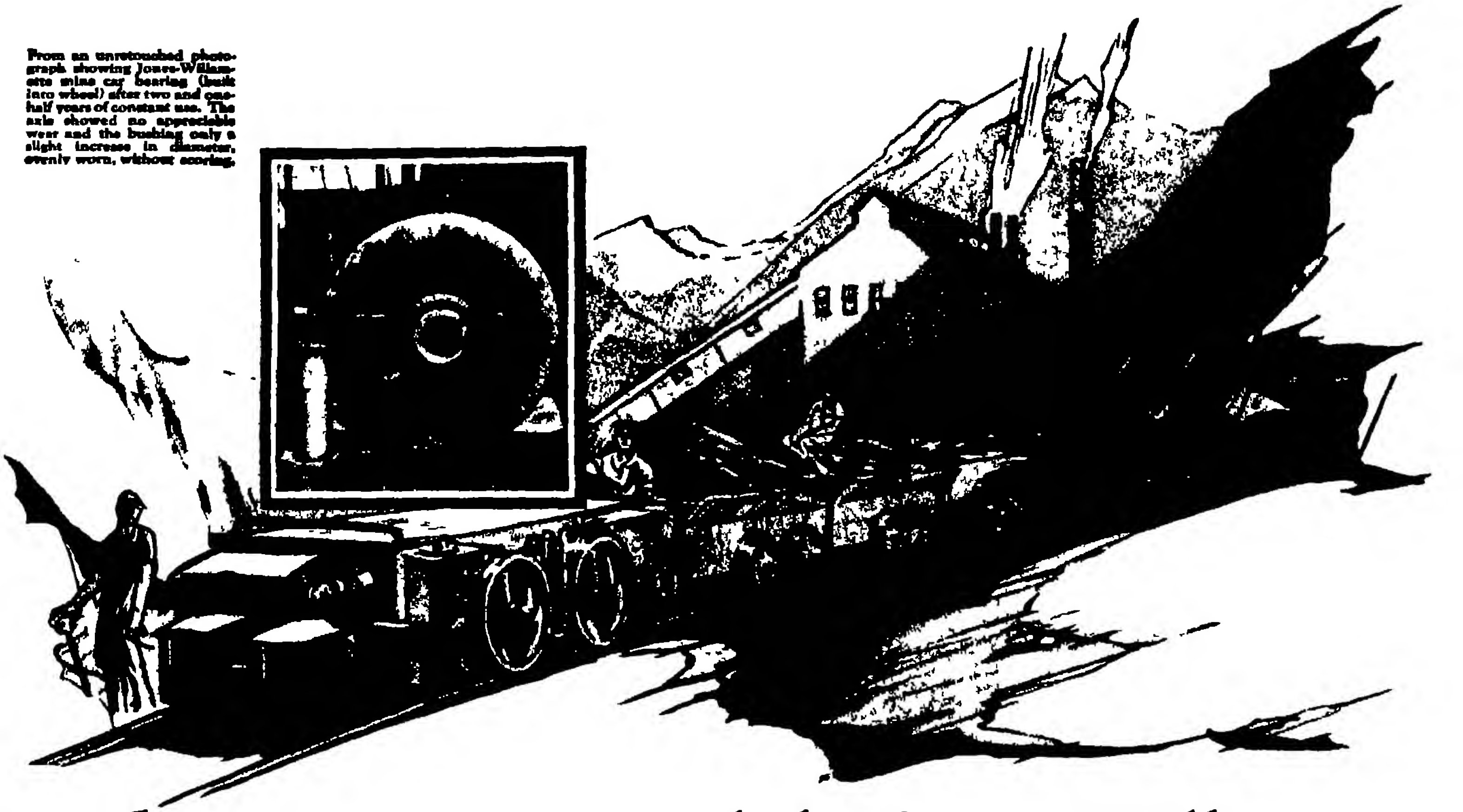
BIRDS

WHERE do the chimney swifts go in the winter? Nobody knows—yet

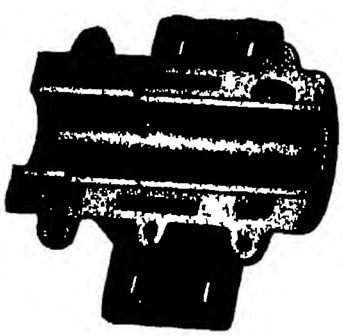
Until comparatively recently it was thought that these strong flying birds buried themselves in the mud on the Gulf of Mexico Now the theory is that they migrate across the Gulf of Mexico and winter in the rain forests of Brazil

Back in the days when investigation and heresy were synonymous, the wise men would have reasoned it out and arrived at a wholly logical, but incorrect, answer. Today we do things differently The Bureau of Biological Survey is trapping more than 25,000 of the birds, putting identification tags on them and letting them go again in an effort to trace their movements

From an unretouched photograph showing Jones-Willamette mine car bearing (built into wheel) after two and one-half years of constant use. The axle showed no appreciable wear and the bushing only a slight increase in diameter, evenly worn, without scoring.



Five *distinct savings* made by Jones-Willamette mine car wheel bearings



**OIL TIGHT
LESS FRICTION
LASTS LONGER**

Action of shaft automatically filters and circulates oil to points of greatest load and friction. Complete lubrication means long life. Bearing completely oil sealed—oil cannot escape nor water enter.

Jones-Willamette mine car bearings have been tested for more than two years in the hardest kind of actual use. During this time the following economies have been fully demonstrated:

OIL ECONOMY—The Jones-Willamette bearing uses approximately one-tenth the oil consumed by other types of bearings, simply by *keeping the oil in after it is put in.*

REDUCED WEAR—Continuous use for two and a half years showed no appreciable wear on axle and very slight wear on bushing. Perfect wheel alignment is the result—no sharp flanges and no cutting of tracks.

POWER SAVING—Tests on mine cars show that substantially less tractive force is required. This is an important power saving, both in operating mine trains and in shifting mine cars by hand.

LABOR SAVING—Instead of constant wasteful oiling at the mine mouth, cars equipped with Jones-Willamette bearings require oiling only once every six or eight weeks. The expense of sanding and of cleaning oil from tracks and mine structures is eliminated.

REDUCED DEPRECIATION — Jones-Willamette equipped mine cars can be run over water and muck covered tracks without sand, grit and water getting into the bearings.

These bearings *keep the oil in and keep everything else out.*

Wheels and bearings are also manufactured for all types of industrial cars and trucks. They give these same economies. Write for information regarding Jones-Willamette bearings, now available in both standard and special types for every industrial use.

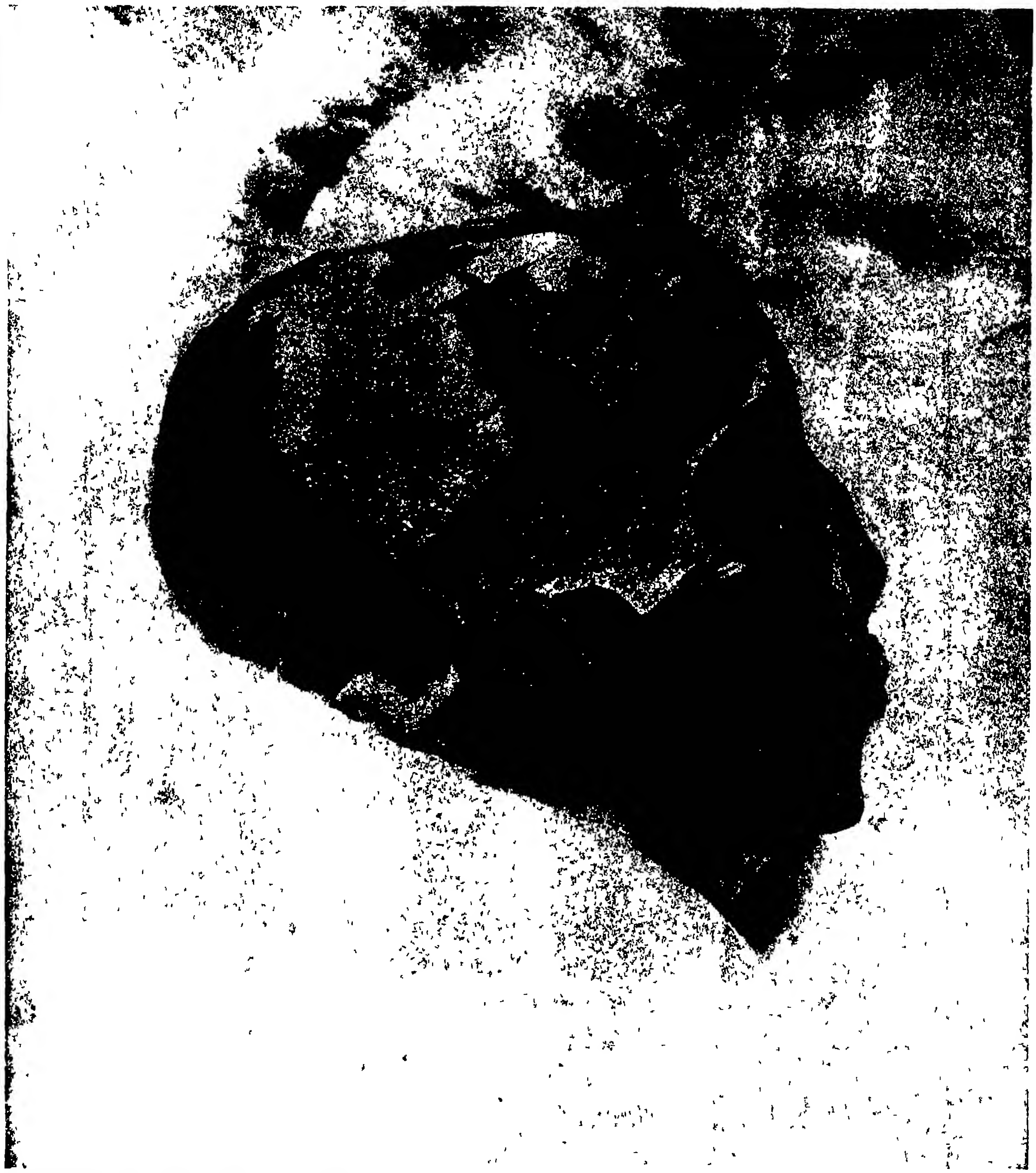
Willamette Iron & Steel Works, Portland, Oregon
Monadnock Bldg., San Francisco L. C. Smith Bldg., Seattle

***Distributors:** A few good territories are still available. Write or wire*

[Jones] Willamette
VACUUM CIRCULATION
Bearings

Senatore Guglielmo Marconi, the Prophet of Short-Wave Radio Transmission

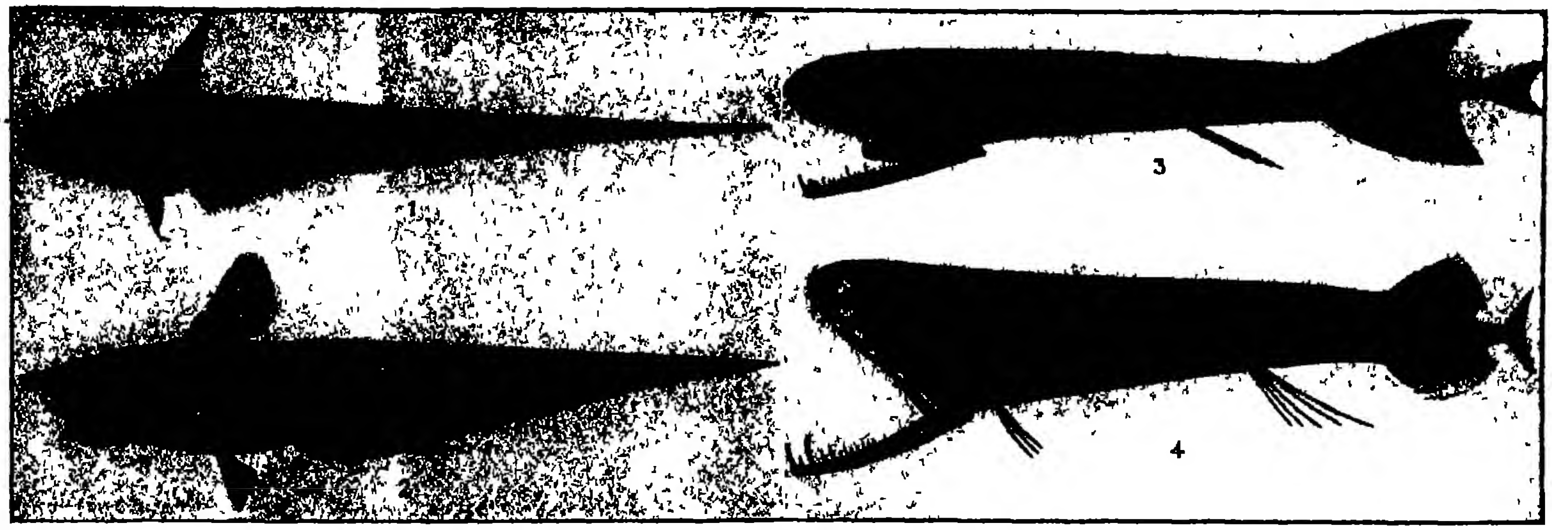
To this well known scientist must go the lion's share of the credit for the commercial development of communication by radio Born in 1874, he was only 27 years of age when he devised the radio apparatus that successfully transmitted the first signal across the Atlantic, without wires. Before that, in 1899, Marconi succeeded in spanning the English Channel by radio, or wireless, as it was then popularly termed. From that time on, progress was spectacular Shipping interests speedily adopted the new form of rapid communication and the science grew apace In 1922, Marconi predicted that, in the near future, the short wavelengths below 100 meters would be found of great value After only four years, the prophecy has already been realized, as is evidenced by the fact that amateur and commercial radio stations are transmitting to the antipodes and beyond, with a very small amount of power The next development that Marconi will announce is conjectural and it will undoubtedly be seized upon with alacrity and subjected to tests by all interested parties.



Photograph from Wide World by Harry Burton Metropolitan Museum of Art, New York City

The Head of Tut-Ankh-Amen, with Its Final Wrappings Removed

The actual mummified body of Tut ankh amen has at last been revealed. Difficulty was experienced in dealing with the mummy for it was in a very poor state of preservation The ancient embalmers did their best, but the Egyptian burial custom more or less defeated them Unguents used in the final consecration of the body destroyed the fabric with which the body was wrapped and also caused the mummy to adhere to the coffin Being of a fatty matter—resin and perhaps wood pitch—the unguents decomposed in the course of centuries, and therefore the scientific unwrapping which had been hoped for could not be carried out Tut-ankh-amen's resemblance to Akh-en-aten, his father-in-law, is particularly striking and the *Illustrated London News* suggests that he may have been a son of Akh-en-aten by a wife of one of the less official weddings of that ruler.



FISHES THAT CARRY THEIR OWN SOURCES OF LIGHT WITH THEM
1 Macrourus bairdi *G and B, from Massachusetts Bay* 2 Coelorhyncus carminatus *G and B., near Martha's Vinyard* 3 Malacosteus niger *Ayres, a small lantern fish from George's Bank, Newfoundland.* 4 Malacosteus choristodactylus *Vaillant, a split fingered lantern fish from the eastern Atlantic, with very minute luminous spots*

Cold Lights of the Sea

Fishes Which Inhabit Great Depths Carry Their Own Lanterns

By David Starr Jordan
Chancellor Emeritus, Leland Stanford Jr University

IT has long been inferred, and for many years positively known, that the depths of the sea are cold and dark We were not sure whether or not they were inhabited by any form of life Poets have assured us that in these regions "sweet flowers are springing, no mortal can see" but botanists have never favored this view, and for generations naturalists believed that we should never find out the truth But in the last century the explorations of the great dredging steamers the *Challenger*, the *Albatross*, the *Travailleur* and the *Talisman* with the fleet of Prince Albert of Monaco, gave us complete and accurate knowledge of the life in the "somber retreats of the ocean"

These explorations have brought to light the fact that fishes occur at all depths, even down to four or five miles below the level of the ocean The fishes of the surface, in the open sea, are all metallic blue above, colored like the sea itself, as a defense against predatory birds who attack from above At the same time they are silvery white beneath, invisible to enemies below, to whom they appear to be colored like the sky

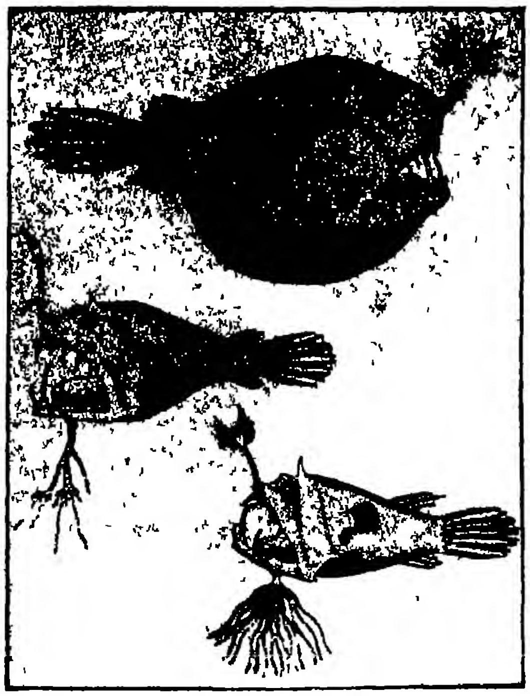
Their Light Has No Heat

The great majority of fishes live in shallow waters, near shore, around rocks or along sandy beaches where they swim in the shallow surf, seldom wandering far from home. Shore fishes are variously colored, some silvery, and some with protective markings of one kind or another which are very effective in hiding the fish that bear them Besides these, multitudes of little fishes with colors so bright as fairly to be termed defiant swarm around coral reefs in the tropics. These gaudy creatures are swift as chain lightning, and seem to need no protection as they find their way instinctively into all the crevices in the reef.

Further down in the open sea at about the depth of the red sea-weed, we find fishes largely plain red, which color usually replaces the yellows, greens, and blues of the rock fishes of the reefs Beyond the depth of a few hundred feet, the reds give way to dark purplish and then to inky black. We now know that black is the invariable color of all fishes from about a thousand feet down to five miles, the greatest depth reached by the beam trawl, the present method of deep-sea angling

The first fish from the black depths was taken in 1810, off Messina, by Constantine Rafinesque It was a little black creature with big eyes Its body was marked with many round white spots, which were luminous in life, although its discoverer did not know it. He gave it the name of *Myctophum*, supposed to mean night light (hence by some changed into *Nyctophos*, a good name but not the one intended, for it was not suspected of any relation to light, save in its black color).

Later collectors have dredged more than a hundred different species of the type of *Myctophum* We have found that they swarm in almost all seas



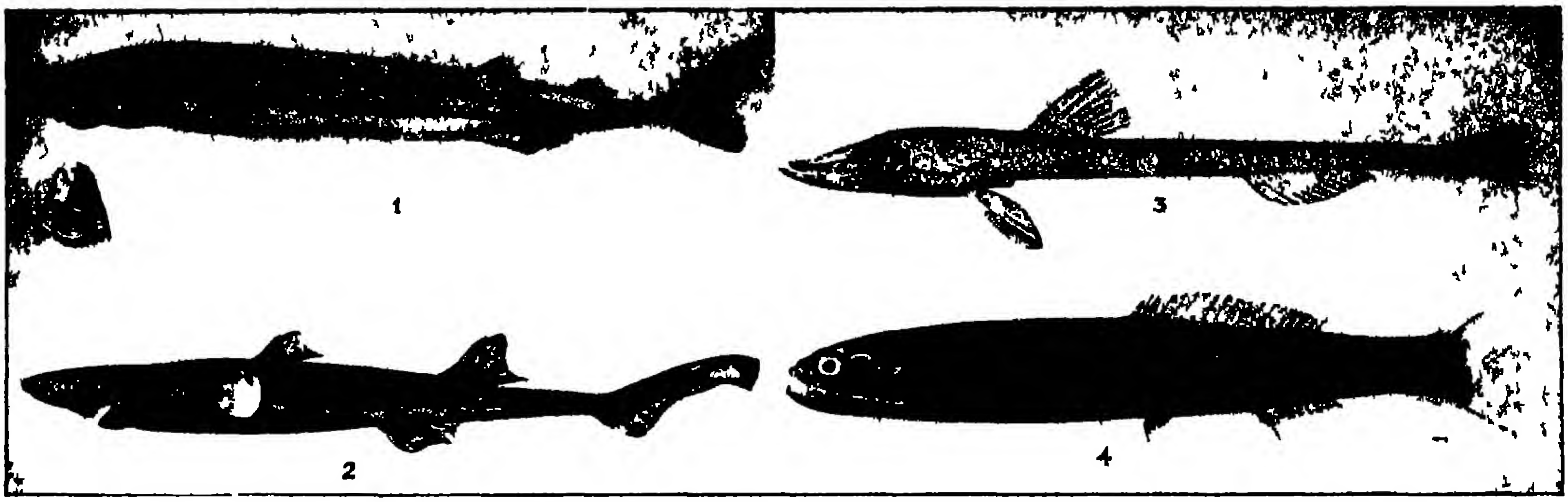
FISHES THAT FISH
These fishes carry luminous glands above them When smaller fish nibble the bait they are engulfed 1 Borophryne apogon *Regan.* 2 Linophryne macrodon *Regan.* 3. Linophryne polypogan *Regan*

and at great depths, but unlike most of their kind they are sometimes caught by storms and thus raised to the surface They are called "lantern fishes," because as we now know, all these round white spots shine in the dark The light they give out has no heat and so I have called them "the cold lights of the sea" All of them have very large eyes and they find their way in the dark by the aid of the lanterns they carry In all cases these lanterns are many, and are variously placed in the different species They are usually ranged in broken rows along the sides of the head and body In two species those in front are enlarged to cover the whole front, like the head lights of an engine

The luminous spots are known technically as photophores (light bearers) In most cases among the lantern bearers they are small and round, about the size of pin heads, either raised above the skin or sunk into it They are sometimes simple, plain shining spots ringed with black pigment. More often each contains a bright reflector, in which case, when they are brought up in a dredge, they "shine like little stars of the sea" Sometimes each spot is divided by a little cross partition, their form then being comparable to the Greek letter Theta (θ) Most of the substance of the luminous organ is granular, excreting slime, which too may be more or less luminous While this light is produced by oxidation there is no evidence that any heat whatever is developed in connection with it

Light Not Due to Bacteria

Many of the phenomena known as phosphorescence, as that of decaying wood, (known in the eastern states as "fox fire") and that of decaying fish ("a mackerel in the sun") are said to be due to the presence of luminous bacteria But with the photophores of fishes this is not the case The more life in the fish, the more light is given out Recent students say that all animal light is due to two substances, Luciferin and Luciferase The first is a fuel, the second a sort of ferment necessary in the oxidizing or burning of the fuel But such combustion produces cold light, with little or none of its energy side tracked as heat waves It is hoped that through the study of Luciferase, some way ma



FISHES THAT SWIM IN THE DEPTHS OF THE SEA FAR BELOW THE THOUSAND FOOT LEVEL TO WHICH DAYLIGHT PENETRATES

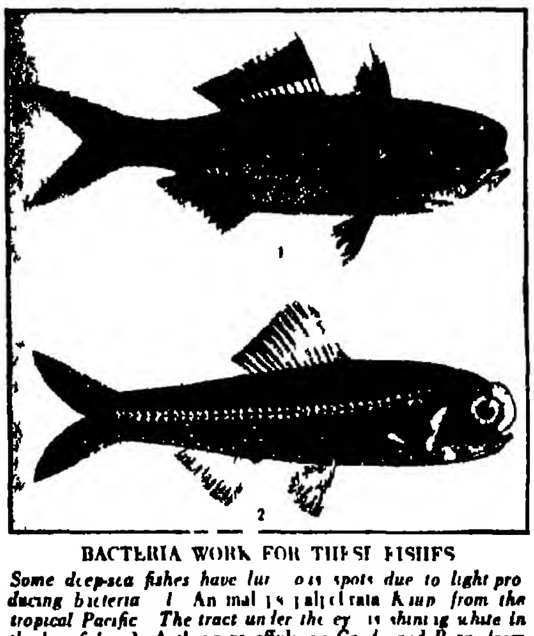
1 Isistius brasiliensis Quoy and Gaimard, the green light sharklet, a very rare species found in the open sea. The whole belly shines with green light (Drawing by Stanley C. Ball). 2 Etmopterus lucifer Jordan and Snyder, the shining or lucifer sharklet from Sagami Bay, Misaki, Japan, taken in 1500 fathoms on a hook and a half mile line. The sides of the belly are luminous. 3 Ipnops murrayi Günther from the West Indies. The eyes and forehead are united in one luminous plate. 4 Bathylagus nigricans G. and B. of Santa Cruz Island, West Indies. It is not luminous. All of the illustrations on this and the preceding page are from one quarter to one half life size

be found for producing it artificially and from it white cold light.

There seems to be nothing in common between the light organs of fishes and those of fireflies and other insects which possess luminous organs. It is also evident that the five types of phosphorescent structures found among fishes are derived independently, through the agency of a common need and not from common heredity. They appear in different groups of fishes apparently not related to one another and each group develops its own particular structure.

Another type of lantern, quite different in structure as well as in purpose, is found in the bait offered by a few kinds of deep sea anglers, known as sea devils and fishing frogs. In these fishes the first dorsal spine is elongated and turned forward, its tip provided with a fringe of tentacles. In the center of this bait is some sort of a luminous gland. These are turned forward over the big mouth and the little fishes which nibble at them are suddenly engulfed.

A third type of luminous organs was lately found by Mr. F. M. Hickling in a species of grenadier (*Malacocephalus lævis*). This deep sea fish was examined in life in the deep sea off the continental rim, between Ireland and Morocco "where the submerged edge of the continent begins to plunge rapidly down to the depths of the Atlantic Ocean."



BACTERIA WORK FOR THESE FISHES

Some deep-sea fishes have luminous spots due to light producing bacteria. 1 Anomalops palpebrata Kaup from the tropical Pacific. The tract under the eye is shining white in the live fish. 2 Aethoprora effulgens Goode and Bean from Gulf Stream, Gulf of Mexico. About one half natural size

The belt is frequented by the beam trawlers which scrape up from the depths many edible fishes unknown to the public at large. The fish studied by Mr. Hickling belongs to the large group called grenadiers or "rat tails" (*Macrouridæ*). The front of these fishes is impressive, looking like a high brow cod fish, the tail is long, slim and rough like the tail of a rat. It is easy to see the origin of each of the common names.

While many deep sea fishes carry lanterns, none had been reported before among the grenadiers. The one in question has light organs quite different from any found in any other group. The fish is about a foot and a half long and it lives at an enormous depth. Its lantern is a large gland lying in the skin of the belly. One gland is on each side of a little scaleless patch. From this gland under pressure of any sort, a slimy luminous secretion is poured out in abundance. Everything becomes smeared with it, the fish itself, the net of the trawl, the surface of the deck and the hands of the fishermen glow with a blue light. If a live fish is thrown back into the sea the luminous slime makes a glowing disk of light as large as a soup plate behind which the creature disappears. By the light of a solution of this slime in water one could read a newspaper or read the hands of a watch."

Piscatorial Songsters

In a fourth group, composed of a few deep sea fishes of the tropics known as *Anomalopidæ* large luminous blotches are developed on the sides of the head. It has been shown that these patches are infested with light producing bacteria, like indescribably minute fireflies.

Still another and very different type of photophore is found in the small group (*Porichthys*) known in California as "singing fishes" and as "midshipman," the latter from a group of shining spots arranged like buttons along its breast and belly. The name "singing fish" comes from its crowding the air from one part to another of the swim bladder making a quavering noise as near singing as a fish can come. Each of the photophores is spherical shining white, and each is made up of four parts: the lens, the gland, the reflector and the pigment. *Porichthys* belongs to the toad fish family and most of the species live in shallow water. It has not the same need of artificial light which is felt by the regular lantern fishes. But while the California and Texas species live in shallow water and are not black, but brown in color, with flesh and naked skin of firm texture, there is another species of the same group found off the coast of Panama in fairly deep water. This species is darker in color, of softer substance and can perhaps make better use of its privileges than our "singing fish."

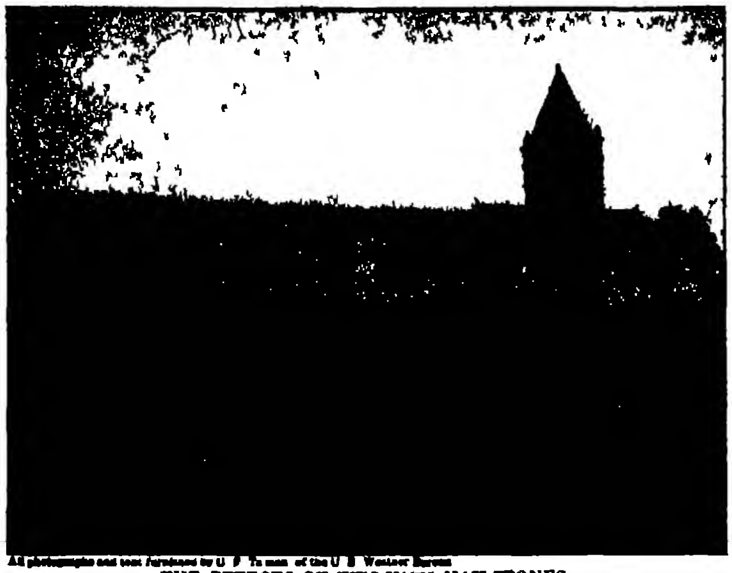
Under ordinary conditions the light of *Porichthys* does not appear at all, but it becomes very bright under stimulation of ammonia or by a strong current of electricity, although even this seems only slightly effective in examples drawn from deeper water. In this as probably in all cases, we have some degree of oxidation burning as a cold fire in the mucous fluids.

A fifth and very different type of luminosity occurs in several sharklets in the deep seas. In these the whole belly is faintly luminous, shining with a diffuse green light. One of these creatures, about a foot long and jet black, (*Etmopterus lucifer*) was once brought up from a great depth in Sagami Bay, Japan. A drawing of this species was later made at night, by its own light from a living example by a Russian naturalist, Peter Schmidt, at Misaki. The same diffusion of green light has been noticed in other small deep water sharks, especially in the little known genus, *Isistius*. No light producing structures have, however, been discovered.

The whole range of phenomena of cold light under the sea is a very interesting one, and it still offers room for much further investigation as does also the kindred one of "torpedo" fishes, which yield vigorous electrical shocks.

SOME SING, SOME GO FISHING

1 Porichthys porosissimus Cuvier and Valenciennes, the Mexican singing fish from the Gulf of Mexico. It is smaller than the Californian singing fish but has larger teeth. 2 Himantolophus groenlandicus Reinhardt, the Greenland sea devil. When turned forward, the luminous tentacles act as baits



All photographs and text furnished by U [illegible] of the U S Weather Bureau

THE EFFECTS OF TWO INCH HAILSTONES

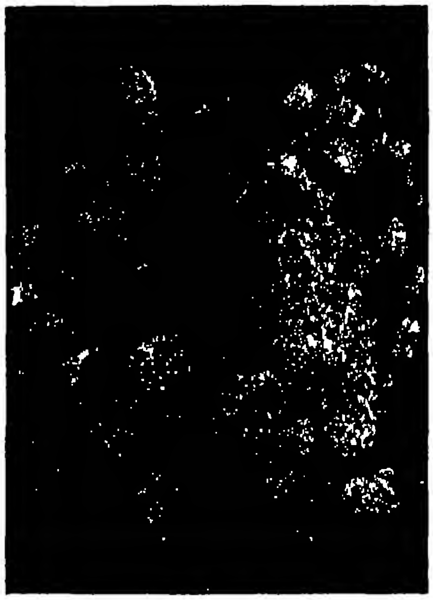
The Public Conservatory at Allegheny, Pennsylvania after the storm of May 20 1893 in which many hailstones were from 1½ to 2½ inches in diameter The hail lasted only five minutes but broke thousands of dollars worth of glass The ground was pitted with holes for weeks after

A NEW HAZARD OF THE HAILSTORM

This picture shows how a few thousand automobiles looked after the tremendous hailstorm in Dallas Texas on May 10 1926 which did damage in that city estimated at 2 000 000 dollars Roofs of street cars were similarly punctured and many tile and shingle roofs of houses were wrecked

A CORN FIELD DEVASTATED BY HAIL

In an average year standing corn in this country is damaged by hail to the extent of nearly 14 000,000 dollars No wonder hailstorm insurance has become popular in the corn belt!



GARNERED FROM A KANSAS HAILSTORM

The question asked after a severe hailstorm is How big were the hailstones? The stone marked 1 in the above picture was 13½ inches in circumference, greatest diameter about five inches Much larger hailstones have been reported but they probably resulted from the melting together of several stones lying closely packed on the ground Hail sometimes falls in astonishing quantities The day after the great Baltimore hailstorm of May 24 1925, a fleet of 10 trucks and wagons was required to remove the huge drifts from the streets Hailstones have been known to pierce a pane of glass with a hole like that of a bullet without cracking the glass and also to bury themselves a foot and a half deep in the ground

WORSE THAN THE BOLL WEEVIL

Cotton stripped of all its leaves by a hailstorm The annual hail loss of this crop is more than [illegible]000 000 dollars In the northeastern states tobacco is a special sufferer from hail

The Direful Scourge Called "Hail"

What is hail? The answer to this question is not quite so easy as you might suppose, and differences of opinion on the subject have led to much confusion Besides snow, three distinct kinds of icy particles fall from the sky One consists of little lumps of clear ice, which the U S Weather Bureau calls "sleet." Another takes the form of miniature snowballs, about the size of coarse shot This is called "graupel" Both sleet and graupel fall only in cold weather True hail is a by product of thunder storms It consists of icy lumps ranging from the size of small peas up to and exceeding that of big oranges The lumps assume a great variety of shapes A typical hailstone has a snowy center, surrounded by from one to a dozen or more coats of alternately clear and snowy ice, arranged like the skins of an onion Hail being an attendant of thunderstorms, is most common in warm weather but it occurs also with the rare thunder storms of the cold season and of the polar regions Hail is one of the most destructive of atmospheric agencies doing damage estimated to average more than 200 000 000 dollars a year throughout the world The greatest losses are borne by field crops In Europe, vineyards suffer heavily and everywhere the glass roofs of greenhouses are favorite targets of hail stones For some reason that has never been satisfactorily explained human beings are seldom killed or badly injured by hailstones Most of the fatalities thus far recorded occurred in India, and were confined to a few storms of extraordinary severity, such as are seldom experienced elsewhere

Bureau of Standards photograph

Buildings of the Bureau of Standards Dr Heyl's Subterranean Laboratory Is Under the Long Building Near the Upper Right hand Corner

The Wonder of the Commonplace

". . Tongues in Trees, Books in the Running Brooks, Sermons in Stones . ." *As You Like It*

By Dr Paul R Heyl

Physicist United States Bureau of Standards

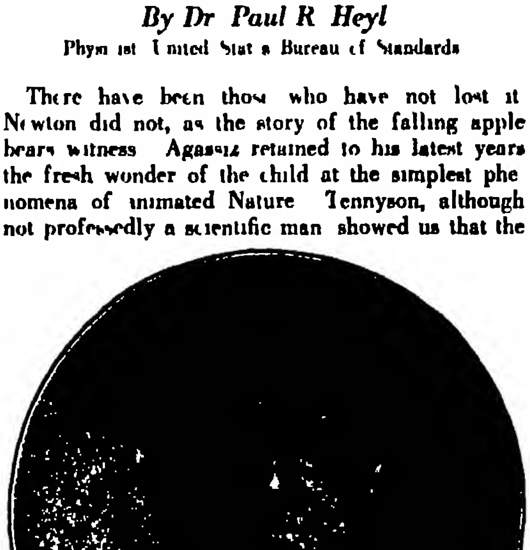
"I CANNOT tell you how much I have enjoyed this visit," said a lady, one of a party of visitors who had been shown through the laboratories of the Bureau of Standards "And now to think of going back to the commonplace things of life! You are fortunate people here And yet," she added reflectively, "I suppose that you are so accustomed to all these wonderful things that you regard them very much as you would—well a falling stone"

For the honor of the craft it was my impulse to deny this, but something stopped me and the train of thought started by her last remark continued long after the visitors had gone Were we or were we not guilty as charged? And yet is it not true that if we do not regard all these wonderful things in the same light as a mere falling stone at least we ought to do so? Not that we should allow ourselves to become blasé irresponsive to the flickering glow of the vacuum tube or cold to the story told by the spectroscope, but rather that we should be equally sensitive to the wonder of the commonplace

The Poet as a Scientist

There is nothing in all Nature more wonderful than anything else when we stop to think about it For not even the most trivial happening can we as yet give any ultimate explanation It is true that there are many things which we have come to regard as commonplace but they have lost for us their real wonder only by reason of familiarity, for familiarity like slowly settling dust gradually masks everything under a uniform uninteresting gray The child has the advantage of us and we may well envy him for to him everything is wonderful because everything is new Every one of us in infancy has had the correct point of view and if with advancing years we have lost it the fault is not in our stars but in ourselves that we are underlings

There have been those who have not lost it Newton did not, as the story of the falling apple bears witness Agassiz retained to his latest years the fresh wonder of the child at the simplest phenomena of animated Nature Tennyson, although not professedly a scientific man showed us that the



DR PAUL R HEYL

Dr Heyl is reweighing the earth at the Bureau of Standards

scientist and the poet are blood brothers when he said of the flower in the crannied wall

"If I could understand
What you are root and all and all in all
I should know what God and what man is"

True we are not all Newtons or Tennysons Far from it some of us have even sunk so low as to swear at the telephone, and are beginning to be a bit impatient with the radio Yet every one of us can do much toward throwing off the benumbing influence of familiarity We were none of us born without the capacity to wonder, and this great gift cannot yet be wholly dead in anyone who thinks it worth his while to read the pages of the Scientific American It has been well said that the remedy for the ills of democracy is more democracy, and the most potent antidote for the effects of familiarity is a more intimate acquaintance with the real nature of commonplace things

Our lady visitor doubtless mentioned the falling stone at random, yet by the most careful thought she could hardly have done better, for, as we shall see, a falling stone is full of interest from every possible aspect The shape of its path is wonderful, the speed with which it moves in this path is, if possible, still more wonderful, and even deprived of its motion and lying inert upon the ground it is still full of interest to those who can understand the language which it speaks

And here, I think, lies the great difficulty As the traveler unacquainted with the speech of a strange country is at the mercy of the unscrupulous, so our inability to understand the tongue of the trees, the language of the brooks and of the stones is perhaps the greatest ally of familiarity in its insidious efforts to close our eyes to the wonders that surround us, but the dust of familiarity disappears under the breath of the interpreter

The Phenomenon of a Falling Stone

At first glance it may seem the height of absurdity to invite comparison between the most magnificent spectacle in the heavens—the rings of Saturn, and the behavior of a stone thrown from the hand, yet a little consideration will show us that the two are essentially one in nature, equal in wonder and mystery

The classic investigations of Keeler at the Allegheny Observatory have shown that the rings of Saturn consist of a collection of myriads of small bodies (we may fairly call them stones), each circling around Saturn in its proper orbit, millions of tiny satellites, each in its path obeying the same law of gravitation that prevails at the earth's surface and

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governs the action of a stone after it leaves the hand that throws it.

A stone thrown upward at any angle describes a curved path and returns to the earth. The mere fact of this return is a wonderful thing, although we do not usually make as much of it as we do of the return of a boomerang. As a matter of fact, we know a good deal more about the reason for the return of a boomerang than we do about that for the return of a stone, for the ultimate nature of gravitation no man knows—not even Einstein.

The shape of the curved path of the stone is also full of interest. Making allowance for air friction, it is a portion of a large ellipse about the earth's center.

If we were to fire a bullet horizontally from the peak of a high mountain, it would not go very far before reaching the earth by a curved path which is also a portion of a large ellipse. The greater the initial speed of the bullet the farther it will travel before striking the earth, in other words, the wider (and shorter) the ellipse will be. If it were possible to give the bullet an initial speed of five miles per second and to eliminate air friction, the bullet would clear the earth in its fall, and continue to revolve around it forever, the ellipse having widened and shortened to a circle. The earth would thus have acquired a tiny new satellite. With a plentiful supply of ammunition we might thus create for the earth a ring system remotely resembling that of Saturn.

P & A Photo

ABOUT 6 000 000 000 000 000 000 000 TONS

The Cavendish torsion balance used at the Bureau of Standards for redetermining the mass of the earth

Mysterious and wonderful as the action of gravitation may be in the heavens, it is no whit less wonderful in its action on the pebble which we toss carelessly from our fingers, and the action of gravitation at close quarters should, if anything, be the more interesting because it is here available for study and measurement by the searching processes of the laboratory.

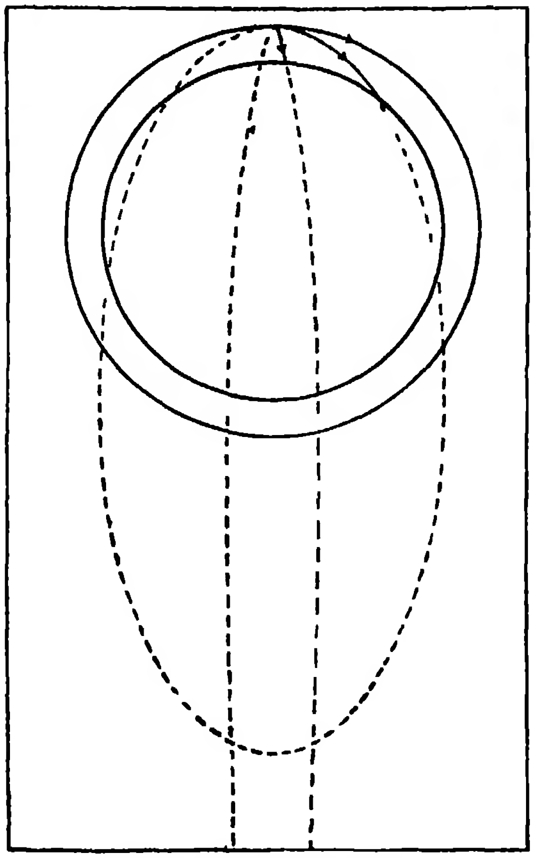
Here again we see the baneful effects of familiarity. The Bureau of Standards possesses a model of the Boys gravitation apparatus, by which the attraction of a five pound mass upon a smaller mass of about an ounce can be made visible by the motion of a spot of light across a scale. Visitors will climb two flights of stairs to see this model, raising their own weight more or less laboriously against the earth's attraction, and think nothing of it, yet the action of the gravitational model never fails to evoke expressions of wonder.

Not only is the mere shape of the path followed by a falling stone wonderful but its speed in this path has attracted the attention and serious study of many careful observers. It is a curious fact that (allowing again for air friction) all bodies without exception fall with equal speeds from equal heights.

> **"Let Down Your Bucket Where You Are"**
>
> **How instinctively do most of us turn, when we seek romance, to places far afield, forgetting that what we seek may be already beneath our unobserving eyes, clothed in the everyday disguise of the commonplace. We raise an arm—can we explain that? Partly. When we read these words and "think," has anyone ever explained that? Yet are not these simple, commonplace acts performed by each of us a thousand times daily?**
>
> ***To few scientists is it given also to be philosophers. Of these, Dr. Heyl is one.***
>
> **The Editor**

The great Greek philosopher Aristotle held the contrary view that bodies fell with speeds proportional to their weights, and supported this doctrine as was the custom of his day and for many centuries after, not by experiment, but by a subtle process of reasoning. It seems curious that such a statement should have gone unchallenged for eighteen centuries when the very simple experiment of dropping a heavy and a light stone together would have disproved it, yet we have no record of any one questioning the authority of Aristotle until Galileo's day.

Some of the most precise experimental work on record has been devoted to this question. It is certainly a remarkable thing that however greatly bodies may differ in every respect that can be imagined they yet behave exactly alike under gravitative action. Bodies of all weights, of all kinds, solid or liquid, hot or cold, transparent or opaque, good or bad conductors of electricity, bodies of terrestrial or of meteoric origin—one and all sink their differences in behavior at the call of gravitation.

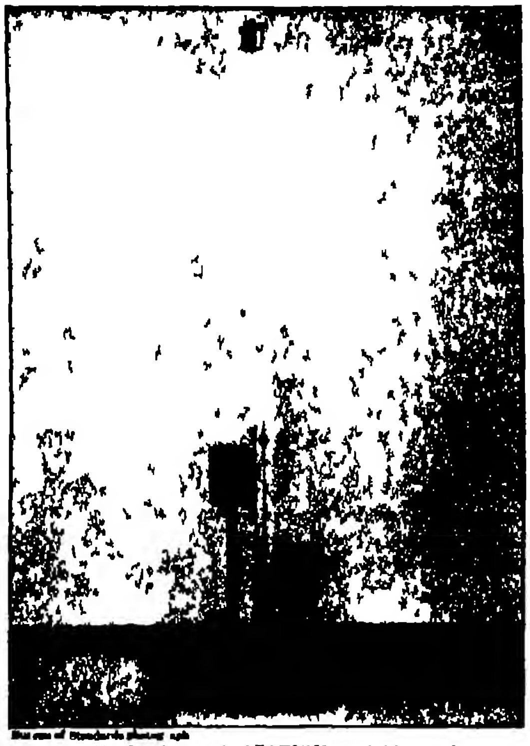


WHEN YOU THROW A STONE

The inner circle represents the earth. The other circle and the ellipses are possible orbits of a missile

Twentieth century experiment has shown this constancy of action to be true to the extent of one part in at least two hundred million. Few laws of Nature have been studied with this precision. This remarkable and exceptional constancy of action has been made by Einstein the foundation stone of his theory of gravitation which (whatever may be said about it) is by no means to be characterized as commonplace.

Wonderful in its path, wonderful in its speed, the stone is still wonderful when it has lost its motion. Falling, it is an object of amazement to astronomers and physicists, and when it falls into the hands of the geologists and chemists the tale it tells them is equally wonderful.



Bureau of Standards photograph

THE BOYS GRAVITATION APPARATUS

Every particle of matter in the universe attracts every other particle. Newton's Law of universal gravitation

"I am old," it says to the geologist. "Old past all speaking. You men creatures travel round the world to gaze upon the tombs and temples of Egypt, things of yesterday compared with the stone of which they are made, for I and my kind saw Egypt born. We felt the heavy tread of the mammoth and the hot breath of the sabre toothed tiger. We lay at the bottom of the sea in the Age of Fishes. Ay, before life was we were in substance like as now. Changeless, we have watched the Pageant of Time, unchanging we shall see the end of that of which we have seen the beginning."

"I am old," it says to the chemist, "yet in your hands I am born into a new life of usefulness. Changeless for ages I have waited the coming of the master who should know how to use me. All my treasure is freely at your service. Will you build a house, paint a picture, sail the sea or fly the air? I and my kind will furnish you the materials. I am old, yet ever young, for although I change my form I never die."

And to every one of us it says: "Wake! for you walk in Wonderland!"

Our Point of View

Excellent Forest Laws

AT last the state legislatures are passing greatly needed constructive legislation to stimulate the building up of the denuded forest lands of the United States. Hitherto owners of cut over forest lands have been discouraged from replanting by the fact that local tax assessors were in the habit of increasing the taxes on lands that were replanted with trees. Henceforth such lands are to be taxed on the value of the land alone, until the trees have attained a growth which warrants their cutting for commercial purposes. Thus, under the New York law, any tract of five acres or more which has been planted with an average of 800 trees per acre, or under-planted with an average of 300 trees per acre since 1921, is to be taxed on the value of the land alone. When, eventually, a cutting is made, the trees must pay a 6 percent yield tax based on the stumpage value. The effect of the new law is to place forest crops more upon the basis of agricultural crops. Other states have passed laws which, while they differ in detail, are based upon the same general principles. Tree lovers throughout the country should bend every effort to get their state legislatures to take similar action.

Science Research at Princeton

PRINCETON UNIVERSITY is asking for an endowment for the specific purpose of strengthening and enlarging its work of research in the fundamental sciences. Its claims upon the liberality of the public have been recognized by the General Education Board, which, after a careful survey of the situation, has generously offered to contribute one million dollars to the endowment. This contribution, however, is subject to the condition that an additional two million dollars be secured by the University. The request for this sum is made with the belief that it will appeal not only to those generous friends who have already helped the University, but also to individuals and foundations that are primarily interested in the furtherance of scientific research. We bring this matter before the public under the belief that Princeton has a special claim upon the support of the public because of its unrivaled record in the promotion of fundamental science during the past twenty five years. The development of Graduate College, the Palmer Physical Laboratory, Guyot Hall, and the addition to the Faculty of a number of men active in research, prove that Princeton has taken a leading part in pure science investigation and training, and it should be remembered that all of this has been accomplished without any adequate endowment for research.

Let us look at some of the concrete facts. It was at Princeton that Joseph Henry developed those discoveries which underlie all dynamo-electric machinery and the first printing telegraph. Here, also, Richardson laid the foundation of the great recent development in radio and multiplex telephony. It was at Princeton that Northrup developed his induction furnace, which promises to revolutionize many processes of metallurgy and which is used in the manufacture of radio tubes and all high vacuum apparatus. At Princeton the directors of several of the largest astronomical observatories in this country were trained; here, moreover, is the leading authority in this country on the interpretation of stellar conditions in terms of modern atomic physics.

The above facts by no means exhaust the list of accomplishment in fundamental physics at this famous University, and remembering that Secretary Hoover only recently warned the country that we were falling behind in the matter of research in the field of pure science, we feel satisfied that the appeal of Princeton for the necessary two million dollars will meet with an early and generous response.

Safety First

IT is with pardonable pride that the railroad officials of Great Britain are able to announce that last year they carried 1,700,000,000 passengers with only one fatality, and that this one passenger was not killed outright but died from shock due to a poor state of health. There were two preceding years—1901 and 1908—when not a single passenger met death in an accident. The significance of this record is heightened by the fact that, because of the comparatively small size of the country, traffic is very dense, for it is evident that the risk of collisions, whether head or rear, increases with the density of the traffic on any given stretch of line. In the cable dispatch announcing this result a railway official is quoted as attributing the safety of travel "to the careful way the traffic was operated, the large number of safety appliances and the excellent signaling system." We are inclined to think that on this, as on any railway system throughout the world, the most important contributory cause to safety is to be found in the discipline of the railway men, that is to say, in their strict adherence to the rules of operation.

The Navy Metal Dirigible

We venture the prediction that the awarding by the Navy Department of the contract for an experimental all-metal airship will be regarded, in future years, as one of the most important events in the history of aviation. The new craft is purely experimental and is too small to be considered in the same class as the *Los Angeles*, compared with which it is only one-fourth as long and has but one-twelfth the gas capacity. The contract was awarded to the Aircraft Development Corporation of Detroit, which is composed of leading automobile manufacturers. The design of the metal ship has been based upon very thorough and costly experimental work in some of the leading laboratories of the country. No one realizes better than the designers of this little ship that it would be folly to build the new navy dirigibles of six million feet capacity entirely of metal. The necessary data on which to base such a design is not available, but if, as its sponsors confidently expect, the small experimental ship is a success, progress will be made by a gradual increase in size of all successive ships, until the all-metal transatlantic liner is set afloat.

Report on Lake Denmark Disaster

A STUDY of the findings of the Court of Inquiry that investigated the recent wiping out of the naval ammunition depot at Lake Denmark leaves one with the conviction that the Court considers the storing of large quantities of high explosives in the midst of a settled district dangerous and in the future to be avoided. It was the writer's privilege to visit the scene of the disaster. The initial explosion caused by a lightning stroke occurred at Temporary Magazine Number 8, which contained, among other material, some four or five hundred tons of depth-charges. A few hundred feet away was Temporary Magazine Number 9, which contained probably over 1,000 tons of TNT. This magazine was not set off by sympathetic detonation from Magazine Number 8, since there was an interval of a minute or so between the two explosions. Climbing the hillside from the roadway one found one's self suddenly on the edge of a vast crater 300 feet long, 200 feet wide and 40 to 50 feet deep. This hollow represented the downward striking energy of the explosion and, as the suddenly liberated gases burst upwards and outwards with a velocity which has been estimated at 30,000 feet per second, they compressed an enormous volume of the surrounding air, which traveled at the velocity of sound and with gradually decreasing pressure, over the surrounding terrain.

Returning to the report, we read that fragments of steel beams were found 5,000 feet away and that the detonation of these two magazines completely destroyed all buildings within a radius of 2,700 feet. As the wave of compressed air traveled over the army arsenal, many thousands of feet away, the wave-like action of the air on the roofs of the buildings crushed them in and left them lying limp, like great stretches of fabric, through which one could see the contour of the piled but unexploded contents below.

The report recommends the establishment of two depots for large quantities of high explosives, located in remote and barren land, one within a thousand miles of the Pacific coast and the other in a similar region within the same distance of the Atlantic coast.

A Fine Record

IF the average citizen were asked to state what institution contributes more than any other to our material prosperity the answers would vary, but whoever should happen to name our railroad system would be close to the truth. Transportation, surely is the very foundation of our material wealth and well-being.

The war hit our railroads a staggering blow. When the government returned them to their owners the management found them to be in a deplorable condition. The roadbed, track and equipment had been allowed to run down so badly that most of the post-war revenue was absorbed by operating expenses. Fortunately the men at the head of our railroads were able, far-sighted and courageous. Realizing that the very first thing to do was to get the system back into good physical condition, instead of worrying about dividends they turned the earnings back into the properties and gradually brought them up to a proper standard of efficiency. Today the tracks, ties, bridges and structures generally, to say nothing of the equipment, are in as good condition as ever before in the history of the railroads.

How do we know this? It is proved by the fact that during the first six months of this year the average freight train hauled about 9,000 ton-miles every hour as compared with 7,300 ton-miles, which was the average performance in 1920. No finer record than this can be found in the whole history of our railroads. It is gratifying to learn, furthermore, that during these six months the whole operating income was nearly 500,000,000 dollars, which is also a record. This is nearly 5 percent on the total property invested. Compare this with 1920, when the railroads earned only 1/8 of 1 percent.

Redetermining the Velocity of Light

By Henry Norris Russell, Ph.D.

Professor of Astronomy, Princeton University

Research Associate of the Mt. Wilson Observatory of the Carnegie Institution of Washington

THE stars are beginning to fade in the earliest light of a California dawn and the observers at the great telescopes on Mt. Wilson end their last exposures, and close the long night's work. The summits of the Sierra Madre begin to stand out dark against the slowly brightening sky But, while most of the work is over, a light shines in one small building on a spur of the mountain, and the attention of the passer-by is attracted by a strange sound which breaks the quiet of the early morning—a shrill note, rising at first in pitch and intensity, and then settling into a sustained scream, resembling that of the familiar warning siren, but more piercing.

The casual visitor—were such passing at this uncrowded hour—might well be perplexed, but the observers of the regular staff, walking back to their sleeping-quarters, say only, "Michelson is having a good morning," for they know that in this unpretentious temporary building, the dean of American physicists is at work on the determination of one of the most fundamental constants of nature, with hopes of attaining accuracy far surpassing any previous knowledge

Visualizing the Tremendous Speed of Light

The measurement of the velocity of light is nothing new. The world has known for generations that it is 186,000 miles a second—to the nearest round thousand. But science is never contented with round numbers—she desires the most precise determination that it is at all practicable to attain

In Professor Michelson's present work—which the writer had the pleasure of hearing explained by his own lips a month ago—a beam of light, reflected from a rapidly rotating mirror, is sent to another mirror at a distant station, and returns after a minute fraction of a second to the spinning mirror again, only to find that this mirror has turned in the interval, so that the reflected ray is not sent back to the source as it would be if the mirror were stationary, but in a different direction This rotating mirror method is a very powerful one for measuring extremely short intervals of time. Suppose, for example, that the distant mirror were a mile away, light would travel there and back in 1/93,000 of a second, hopelessly too short a time, apparently, to measure But suppose that the mirror were turning at the rate of 500 revolutions a second—a quite attainable speed. In this short time it would have turned through 1/186 of a revolution, or nearly two degrees. The reflected ray is deviated twice as much, or almost four degrees. Run the mirror backwards and the deviation is four degrees in the opposite direction The difference of nearly eight degrees between the two results can be measured to much less than a thousandth of a degree—which amounts to saying that the "light time" of 1/93,000 of a second can be measured to less than a ten-thousandth of its own amount.

It is evident that for a complete determination of the velocity of light we must measure three quantities: the distance of the remote station, the rate at which the mirror is turning, and the angle through which the reflected beam is deviated. And, of course, to measure any one of them with the highest precision is hard work. If, however, we could get along by measuring two quantities instead of three, the problem would be much simplified, and Professor Michelson has done this in a very characteristic fashion, by a device as simple as it is effective

His rotating mirror is many-sided—its cross-section, at right angles to the axis about which it spins, being a regular polygon which, in the apparatus now in use, has twelve sides All the faces are accurately figured, polished and silvered, so that in one turn of the axis, twelve successive mirror surfaces come into the path of the light. If the mirror can be spun fast enough, it is possible to catch the returning beam of light, not on the surface from which it was originally reflected, but on the next. For example, the present distant station on Mt San Antonio is some 22 miles from Mt Wilson Light takes about 1/4,200 of a second (in round numbers) to make the return journey. If the mirror is spun at 350 revolutions per second (a possible rate) it will make just 1/12 of a turn in this interval The returning beam will find the next successive face of the mirror exactly where the preceding one was when it started, and will therefore be reflected along just the same path as it would have followed if the rotating mirror had been at rest For faster or slower speeds of revolution, however, it will be deviated by varying amounts.

With this arrangement, therefore, it is only necessary to find the mirror-speed at which the reflected ray is sent back in just the same direction as from a stationary mirror, and we can then be sure that the light-time is exactly 1/12 of that of a revolution The word "exactly" is here used advisedly. The twelve successive angles between the faces of the mirror are made as nearly equal as instrumental skill can produce them to the theoretical value of 150 degrees, but since the reflected image which the eye can see is made up of thousands of successive flashes reflected from all the mirror faces, its apparent deviation depends on the *average* of the twelve angles—and this must be *exactly* 150 degrees

To get a precise determination, therefore, only two things need to be measured—the distance of the mirror on the remote mountain and the rate of rotation of the spinning part of the apparatus.

The Cause of the Scream

The first of these has been found, once for all, by the cooperation of the United States Coast and Geodetic Survey, which executed a special and very precise triangulation for the express purpose. The measurement of the second is accomplished with the aid of a tuning-fork driven by electrical means at a very uniform rate. At every vibration of the fork, a beam of light from a little mirror, attached to one of the prongs, is reflected on to the revolving mirror, and thence to an auxiliary eyepiece If the periods of vibration of the fork and of rotation of the mirror are exactly the same, the successive reflected flashes will fuse into an apparently stationary image, but if one is going faster than the other by even the minutest fraction, this image will appear to move. (This stroboscopic method is of course familiar.) The rotating mirror is driven by a little compressed air turbine (which when running gives out the ear-piercing shriek which was mentioned at the start). An assistant, with his hand on the throttle of this turbine, and looking through the eyepiece of the stroboscopic system, can adjust the speed of turbine and mirror so that the images are stationary—that is, so that the period of the mirror is exactly that of the fork Such an adjustment can be kept satisfactory for only a few seconds at a time, but this suffices, for at such moments—indicated by a suitable signal, Professor Michelson, at the eyepiece in which is seen the image produced by the light which has been to the distant station and back, can make his settings which measure where the reflected ray has been sent

If the rate of the fork is precisely "right" the mirror would have turned exactly 1/12 of a revolution in the light time, and this reflected image would be in just the same place as that given by a stationary mirror Actually, the interval defined by the fork will be slightly too short or too long, and the position of the reflected image a little to the right or to the left. By running the mirror backward (which can be done within half a minute or so) the image is now deviated by an equal amount on the other side of its ideal position The combination of the two settings suffices to determine with extreme precision just how much longer or shorter the light-time is than the time of one beat of the fork. It remains to find this difference—which varies slightly from day to day with changes in temperature This is again done by a stroboscopic method by which the fork is compared with a standard pendulum, itself very carefully calibrated.

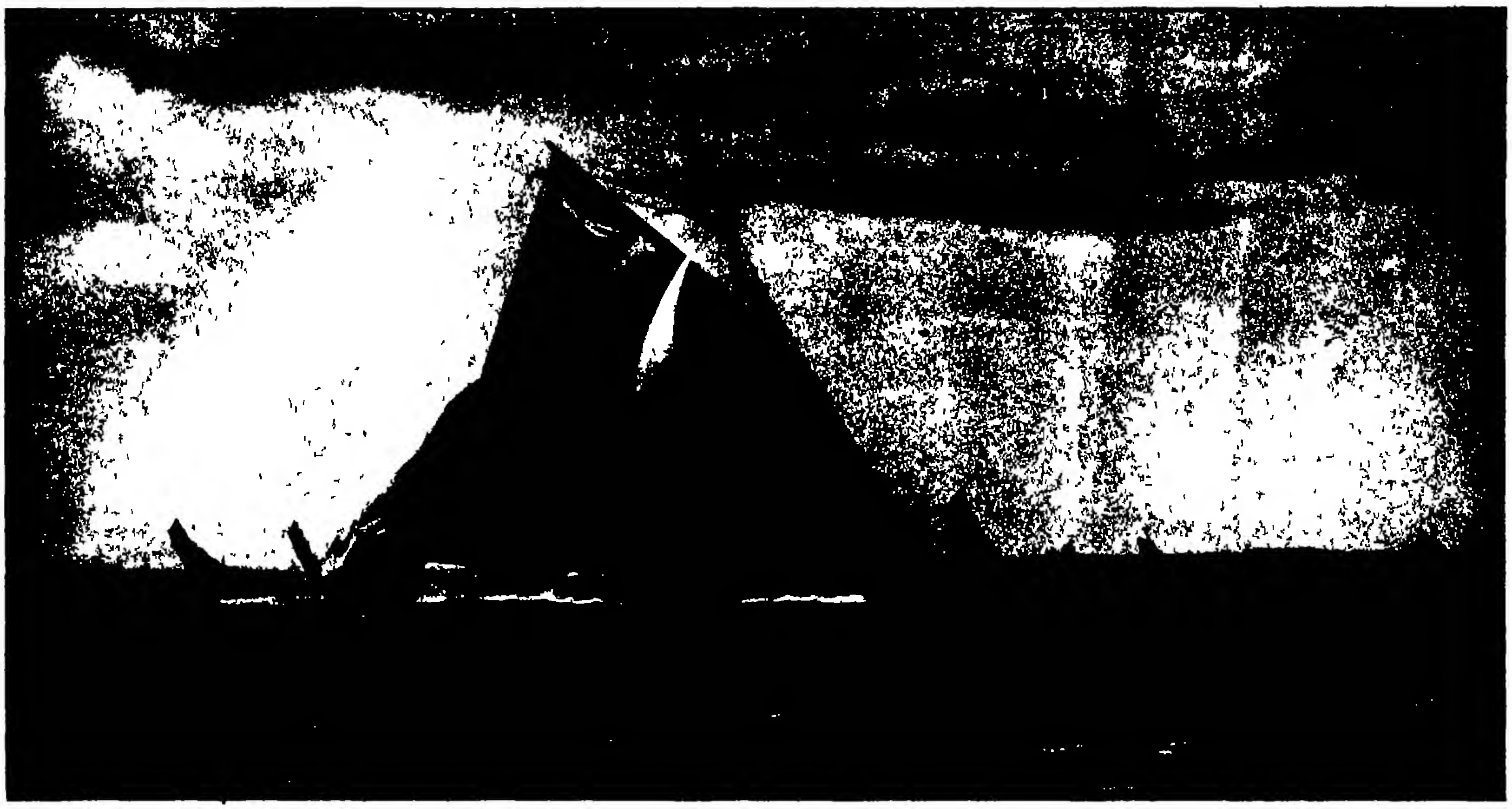
"Such Good Fun"

The original beam of light comes from a military searchlight of the highest power After passing through a narrow slot, and being reflected from the rotating mirror, it is rendered parallel by a two-foot concave mirror, and sent to the distant station —there to be returned precisely along its course by a beautifully simple optical device When the rotating mirror is held fixed in the proper position, the return beam is visible to the eye, looking like a brilliant star on the mountain side By an ingenious arrangement of the optical train, the faint returning beam of light is caught, not on the same face of the mirror as the intense original beam, but on the opposite one—thus avoiding the stray light which would otherwise drown it out.

It is already known that the results of observation on many nights agree so well that we may hope for a final value which will be accurate well within ten miles per second and perhaps a good deal better. But why should months and years of labor be spent in seeking such great precision?

Professor Michelson, speaking recently to a group of students of science, gave two answers. One is that such accuracy may be of practical value in precise surveying If we want to know the distance of a mountain a hundred miles away within a foot or two, it can be found by a trigonometric survey with the expenditure of great labor and cost, provided that this mountain can be sighted on from at least two others in different directions. When once the velocity of light is known as accurately as Professor Michelson hopes to find it, the distance would be measured in a few nights' work—measuring the light-time—with the same precision And even in the case of an island visible from but one peak on the main land, his method would succeed when the ordinary one would not work at all

"But," said Professor Michelson, "I will confess that this is not my main motive My real reason for wanting to do this is that it is *such good fun*" Cold type cannot convey the impression which his hearers gained from the flash in the eyes of this veteran of science as he made this confession But anyone who knows the deep fascination of investigation, and the joy of successfully overcoming obstacles, may understand



THE *VIGILANT* DISMASTED IN STRONG BREEZE

Photograph taken during trial races between the Vigilant *and the* Defender, *at the moment when the topmast and bowsprit carried away*

The "America's" Cup Defenders

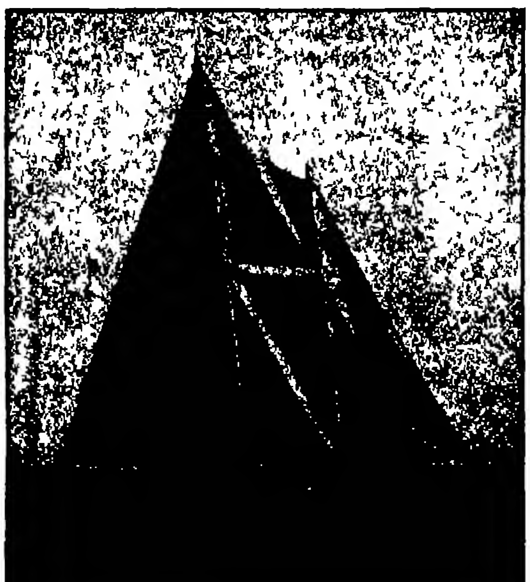
What Has Become of the Famous Yachts Which Have Successfully Defended the Cup Since It Was Won 75 Years Ago

By J. Bernard Walker

SOME three quarters of a century ago, England was occupied with the great industrial exhibition of 1851 in London. In the previous year, an Englishman had suggested that America send over one of her famous pilot boats to sail against the schooners of England during the exhibition year regattas. George L. Schuyler and John C. Stevens, together with three or four other yachtsmen, authorized the construction of a boat to be sent across for the English racing. On the appearance of the *America* at Cowes, she created a sensation, so different was she from the English yachts—both in hull and rig. The time honored English model showed a bluff bow and a fine run. The *America* had a fine hollow bow and her greatest beam was about amidships. Her sails of cotton set very flat and were laced to the boom. The English sails, made of flax, were not laced to the boom and presented a relatively baggy appearance.

In the famous race of 55 miles around the Isle of Wight against a fleet of 17 cutters and schooners, the *America* quickly showed her superior sailing qualities, especially against the wind. She worked her way through the fleet and finished so far in the lead that no other yacht was visible at the finish. This contest was for a cup offered by the Royal Yacht Club. The term "Queen's cup" is a misnomer as applied to the *America's* cup.

The *America*—built of wood—was 95 feet on deck, 23 feet beam and drew 11 feet of water aft. After the race she was sold to Lord John de Blaquière, who raced her for the remainder of the season. He sold her to Lord Templeton, who laid her up in 1854 at Cowes, where she remained until 1859 and suffered severely from dry rot. She was bought as old junk, but was rebuilt on her original lines and



RESOLUTE AS A SCHOONER

Note the new trysail rig between fore and main masts

put in first-class condition. In 1860, she again changed hands and her owner cruised with her in the West Indies. We next hear of her at Savannah in 1861, where she was fitted out as a blockade runner. Eventually she was sunk, to escape capture, in the St. John's River. Raised by the government, she was sent to Annapolis, where she served for several years as a practice ship for the cadets. In 1870, General V. F. Butler bought her. He raced the old ship and cruised in her, but she was not a match for the improved schooners of later years.

Finally, the *America* was presented to Annapolis, and today, minus her spars, she lies in a basin at the Academy, where the writer had the pleasure of inspecting her a couple of years ago. Although not a stick of the original ship remains, her lines, with the exception of a lengthened stern, are probably those of George Steers, her original designer.

The *America's* cup was won on August 22, 1851, and 18 years were to pass before an attempt was made to bring it back. The first challenger was Mr. James Ashbury, who brought over his schooner, the *Cambria*—98 feet on the waterline. The British boat was opposed by a fleet of 14 yachts and finished in the eighth position. Nothing daunted, Ashbury challenged for the following year, with the stipulation that the races should be held against a single boat instead of a fleet. This was granted, and when the challenger, with a new schooner, the *Lavonia*, came to the line, there were two boats to meet her (one of which was to be chosen for the race)—the *Columbia*, a light-weather boat, and the *Sappho*, a

powerful boat in heavy weather In the first three races, he was opposed by the *Columbia* and in the last two by the *Sappho*

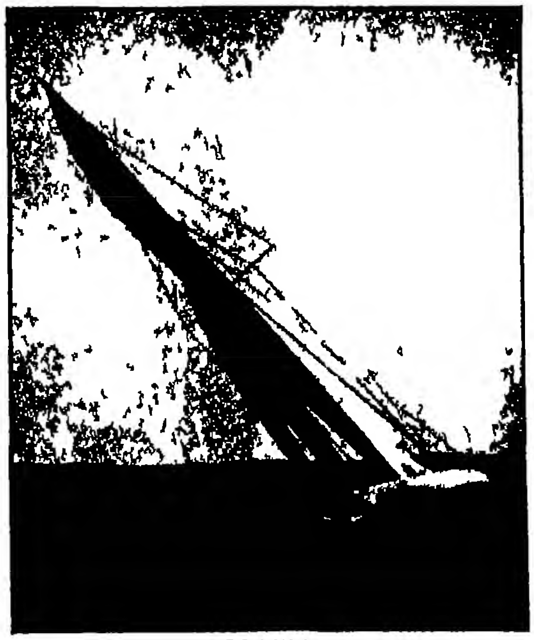
Although James Ashbury was unsuccessful, he did good work for the future of American cup racing, by securing the concession that future races should be between two boats, named months in advance of the races Five years later, in 1880, the Canadians made an unsuccessful attempt to win the cup with a schooner, and in 1881, they failed again, this time with a sloop

The year 1885 is memorable because, in that year the schooner disappeared from the cup contests which henceforth, for several years, were fought out between the American centerboard sloop and English deep keel cutter Sir Richard Sutton had challenged with his racing cutter, the *Genesta* To meet her Edward Burgess of Boston designed the sloop *Puritan*, 81 feet 1½ inches water line, beam 22½ feet, draft 8 feet 8 inches The *Genesta* narrow and deep, was 81 feet 7½ inches on the waterline, 15 feet beam, and 13½ feet draft The broad beamed, shallow, small displacement centerboard was too fast for the narrow heavy displacement cutter The cup remained in this country

The Cutter Type Is Adopted

Subsequent to the races, the *Puritan* was changed to a schooner for cruising then was sold to the Portuguese, who carried natives from Cape Verde to New Bedford for the fishing season Remarkable to relate, this famous craft is still afloat and doing good service as a motor fishing boat, taking parties out for deep sea fishing off the Atlantic coast.

The following year—1886—Lieut William Henn of the Royal Navy brought over another typical English cutter—the *Galatea*, built of steel and carrying 80 tons of lead in her keel Her length on the waterline was 86 80 feet, beam 15 feet, draft 13 50 feet To meet her a group of Boston yachtsmen, headed by General Charles J Paine, built a Burgess designed and improved *Puritan* which was named *Mayflower*. The *Galatea* which was more cruiser than racer, was inferior to the *Genesta* and the American sloop had no difficulty in disposing of her by wide margins The *Mayflower*, like the *Puritan* subsequent to the cup races was changed into a cruising schooner and was a familiar figure for several years in yachting circles This fine yacht was destined for a tragic end Shortly before the World War an expedition of Harvard men sailed with her to the



THE *RESOLUTE* UNDER SLOOP RIG
She has just come around on port tack Note th ual

West Indies, were struck by a hurricane and abandoned her The *Mayflower* survived the storm, was picked up by West Indian natives and taken to one of the islands, where dry rot and the elements ultimately destroyed her

The quest of the *America's* cup was earnest and continuous in those days The following year a syndicate of Scotchmen challenged with a handsome steel built cutter, the *Thistle*—86 50 feet on the waterline The British had changed the yachting rules, and taken off the heavy penalty on beam Hence, the *Thistle* showed the unprecedented beam for an English cutter, of 20 2 feet For the third time, Boston, under that brilliant yachtsman General Paine, came to the front with a Burgess designed steel, centerboard sloop, the *Volunteer* The *Thistle* as her designer Watson afterwards admitted was too much cut away in her forward sections She could not point up with the *Volunteer* and was badly beaten The *Volunteer*, after the races was changed to a schooner and was used as such for many years by J Malcolm Forbes Subsequently after being used as a fishing schooner she was broken up

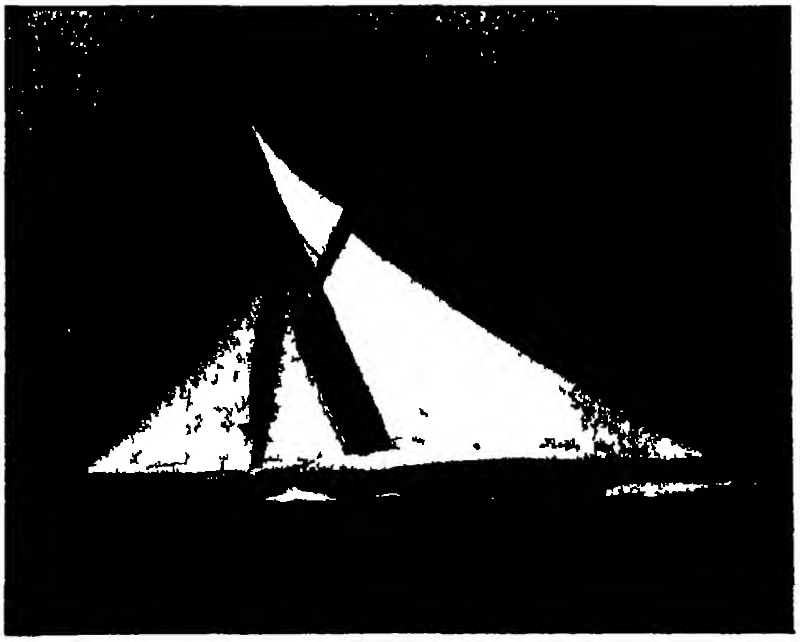
Six years intervened before Lord Dunraven an ardent, experienced yachtsman, challenged, in 1893, with his Watson designed cutter, the *Valkyrie II* This contest was important for the fact that it brought Herreshoff into the field as a designer of cup defenders and from this time on, the cost of cup yachts mounted to extraordinarily high figures The new Herreshoff boat the *Vigilant* was 86 19 feet waterline 26 25 feet beam 13 5 feet draft and she carried the typical American centerboard She was built of bronze plating on nickel steel framing and carried a crew of 60 men In these races for the first time a cutter beat a centerboard sloop to windward and although the *Valkyrie* lost the series, it was evident to yachtsmen that the day of the centerboard sloop was over and that future defenders would embody the deep keel and outside ballast of the cutter type The *Vigilant* subsequently was changed to a yawl and raced successfully for many years under that rig before being broken up for her lead and bronze

"Defender" First Deep keel Boat

Two years later in 1895 Lord Dunraven appeared on the Sandy Hook course with the *Valkyrie III*, which showed the great beam for an English cutter, of 26 20 feet and carried a sail spread which was even greater than that of the American defender To meet her a syndicate of New York Yacht Club members built from Herreshoff designs a remarkable boat the *Defender* She marked the end of the centerboard sloop and the entrance of the American cutter In her deep keel (19 feet draft) she carried 85 tons of lead Her framing was nickel steel her under water plating was bronze, and a light aluminum alloy was used on her topsides deck and deck beams She was successful in retaining the cup, but subsequently her aluminum alloy parts deteriorated so rapidly that she was sent to the break up yard Her last sail was her finest William Butler Duncan sailed her from New London to City Island in smooth water under the lee of Long Island in a gale of wind The boat was under mainsail foresail jib and jib headed topsail The wind was southeast, and since she was to be broken up Mr Duncan was willing to take a chance on her spars in an effort to see what the *Defender* could do The reach of 85 sea miles was covered at an average speed of 13 86 knots! The *Defender* was broken up at Hawkins' Yard, City Island in 1901

The next series of races which opened in 1899, introduced a new figure in international competition

THE *COLUMBIA* TWICE DEFENDER OF CUP
The most successful of the famous Herreshoff designed cup yachts



THE MIGHTY *RELIANCE*
Most extreme and powerful ninety foot racing yacht ever constructed

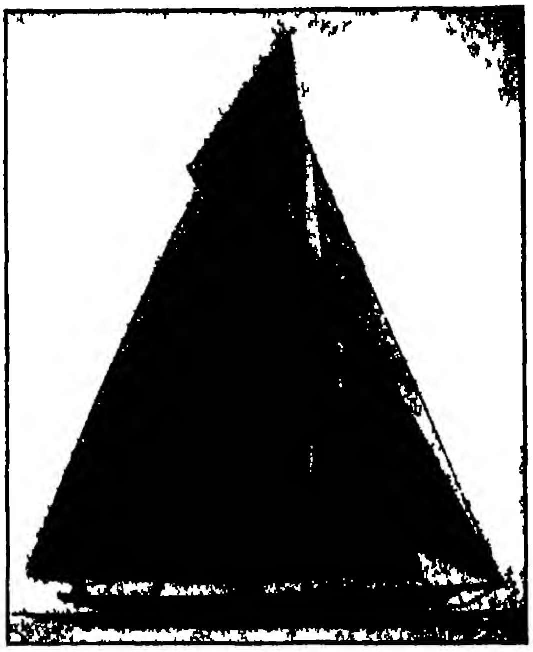
in the person of Sir Thomas Lipton, who was destined to make four separate and gallant attempts to win the *America's* cup. Cup racing had become an exceedingly expensive pastime and Sir Thomas, a man of great wealth, was able to give his yacht designers a free hand so far as expense was concerned. His first yacht, the *Shamrock*, designed by Fife, 87.69 feet on the waterline, showed the characteristic beauty which marks Fife's boats. To meet her, a New York Yacht Club syndicate launched from Herreshoff's designs, a beautiful bronze boat, the *Columbia*, 89.66 feet long by 24 feet beam by 19.75 feet draft, which achieved a rather easy victory over the Fife cutter. The *Columbia* spread 13,136 square feet of sail.

"Shamrock II" Dangerous Challenger

Undismayed by his failure, Sir Thomas returned in 1901 with the *Shamrock II*, which stands in the records today as the most dangerous challenger in all the 75 years covered by the cup contests. Designed by Watson after exhaustive tests of various models in the towing tank, this bronze boat, 89.25 feet on the waterline, spread no less than 14,027 square feet of canvas. To meet her, Herreshoff designed the *Constitution*, which, although she followed the model of the successful *Columbia* rather closely, failed to come up to expectations—so much so that the *Columbia* was chosen to meet the *Shamrock II*. In the races the *Shamrock II* proved to be the faster boat on the wind and running. In reaching the *Columbia* was the better boat.

Unfortunately, the skipper and crew of the *Shamrock II* failed to get the best out of her and she was beaten by close margins by the *Columbia*. Captain Barr, who sailed the *Columbia*, told the writer that the *Shamrock II* was actually the faster boat and that had she been properly handled, would probably have taken back the cup. She never left this side of the water but was broken up at Robbins' Yard, Brooklyn, New York. The *Columbia* was laid up at Hawkins Yard, City Island, where she shared the same fate in 1915.

Two successive defeats and a total expenditure of over 500,000 dollars apparently did not discourage Sir Thomas, for in 1903 he made his third appearance at Sandy Hook with a new challenger, the *Shamrock III*—a handsome and beautifully modeled ninety footer designed by Fife. To meet her, Herreshoff designed the *Reliance*, by far the largest and most powerful cup yacht ever produced, or likely to



VANITIE AS SLOOP AND SCHOONER

Both drawings are made to the same scale and they show the smaller spread of canvas of the Vanitie as a schooner

be built, in the future history of America's cup races. With a waterline of approximately 90 feet, she had a beam of about 26 feet. The *Reliance* was a great departure. Her hull was of the scow type, measuring 142 feet on deck; she drew about 20 feet and carried in her keel not less than 100 tons of lead. Above this hull was a sail spread of over 16,000 square feet as against a sail spread for the *Shamrock III* of about 14,000 square feet. The *Shamrock III* showed ability to hold the *Reliance* to windward under certain conditions of wind and sea, but she was outclassed in reaching and running and the *Reliance* scored an easy series of victories. The great yacht was laid up immediately after the races and was broken up at Robbins' Yard, Brooklyn, in 1914.

Just here mention should be made of the great cost of building, tuning up and racing a modern cup defender. The total cost of the *Reliance*, including her designer's commission, the construction of the hull, rigging, spars and the seven suits of sails which she carried, the hire of tenders to house the crew, the hire of tugs, et cetera, ran up to 410,000 dollars. The cost of the *Independence*, built by Lawson of Boston for cup defense, although she was only three months in commission, was 205,000 dollars. Each of the two mainsails for this boat cost just under 3,000 dollars. Not much of these great sums of money was recovered. The hundred tons of lead from the *Reliance* brought 10,000 dollars and the 30 tons of bronze from her hull, 3,300 dollars. Her sails were sold for 3,600 dollars, her mast and spars for 1,000 dollars and her blocks and other gear for about 500 dollars, making a total recovery of 18,400 dollars out of her total cost, for the whole season, of 410,000 dollars.

In 1914, Sir Thomas Lipton brought over the *Shamrock IV*—a smaller yacht, 75 feet on the water line and of composite build. She was beaten by the 75 foot bronze boat *Resolute* in a series of races which was held soon after the World War. The *Resolute* has been re-rigged as a staysail schooner and is racing this season against the *Vanitie*—a Gardner boat which was built for the defense of the cup and sailed some spirited contests against the *Resolute*. Thus far in the present season's races, the *Vanitie* has shown a decided superiority over the *Resolute*.

Will the Schooner Come Back?

As to the future of the *America's* cup—whether it will continue to be the object of fierce yachting rivalry, or whether it will rest, seemingly forgotten, in the custody of the New York Yacht Club—who can tell? It is our hope that the action of Sir Thomas Lipton in challenging with a 75 foot instead of a 90 foot yacht will have a beneficial effect because of the lower cost of the smaller vessel; also, we rather expect to see a revival of the schooner in future cup races, particularly in view of the great interest which is being shown in the schooners because of the introduction of the new staysail rig.

The preference shown by racing men for the cutter or sloop over the schooner, has been due largely to the superior ability of the former when sailing to windward. It has been difficult to bring the old gaff foresail of the schooner snugly up to the wind. Several of the crack schooners have substituted this year, a staysail rig between foremast and mainmast. For windward work, this is more effective than the old gaff headed foresail. There is no finer sail for windward work than a well cut jib, and the staysail rig is based partly upon that fact and partly upon hints from aeronautical laboratories as to the action of the air on airfoils.

THE FAMOUS *AMERICA*

Shown with a later and improved rig racing against more modern schooners

THE BURGESS-DESIGNED *VOLUNTEER*

The first defender built of steel. She defeated the Watson-designed Thistle

The Salvage of the "S-51"

A Feat of Engineering Without Precedent in Naval Records

By Edward Ellsberg, Lieut Commander Construction Corps, U S N

Officer directly in charge of the salvage and diving operation

THE *S 51*, which has recently been recovered from the bed of the sea where she had lain in 132 feet of water for the greater part of a year, is one of a class of four similar submarines She has the following dimensions Length, 240 feet, beam, 21 feet, 11½ inches, surface displacement and speed, 1,001 tons and 14 2 knots, submerged displacement and speed, 1 230 tons and 9 knots She was practically new, only about three years old

She was sunk at 10 24 P M September 25, 1925 At that time she was operating as a surface vessel, course about northwest, speed 11 5 knots She was struck 30 feet forward of the conning tower on the port side by the *City of Rome* the angle of impact being 40 degrees abaft the port beam (actually measured in drydock from trace of stem and fore foot of the *City of Rome* in the *S 51's* side) A hole 13 feet deep and 2½ feet wide was made at frame 54, coming about the middle of the battery room, which is the main living compartment

Admission of a large volume of water forward caused the *S 51* to trim deeply by the head and it appears that she planed under before she actually took in enough water to sink her She disappeared in less than one minute, still going ahead with considerable speed, and struck bottom in 132 feet of water, bow first, with such force as to buckle up the shell plates completely around her hull at bulkhead 43, this being the point where she changed from single to double hull construction

Dove Six Feet into Hard Clay

At the time of collision, all interior doors were open for ventilation purposes in accordance with the operating design of the boat All hatches were closed, except the conning tower hatch All valves from the external ventilation main to the compartments were open

The crew were all drowned with the boat, with the exception of three men who were asleep in the battery room at the instant of collision These men escaped, and being clothed only in their underwear managed to keep afloat The captain, two other officers, and two seamen who formed the bridge watch were on deck as the vessel sank but all were drowned, as they were unable to keep afloat in their heavy clothes until the *City of Rome* could get a boat over Two other seamen from the inside of the boat also escaped, but were drowned outside Twenty six members of the crew, including three officers, were drowned inside the boat their bodies being found in every compartment While the boat was sinking it is evident that the crew inside did their utmost, as the bodies were generally found at their stations, and in many cases still grasping valves or controls Owing to the rush of water no doors could be closed, and the boat was found completely flooded

As discovered (by an oil and air slick) the next morning, the *S 51* was fourteen miles to seaward of Block Island and about fifteen miles southward and eastward of Point Judith She was resting at an angle of 13 degrees to port, and buried about six feet deep in a bed of hard clay mixed with some sand The *S 51* was headed practically north (350 degrees)

As a desperate measure, in case life existed inside the boat, an attempt was made to lift the stern with derricks hired from a wrecking company Five days elapsed before a sea prevailed that was calm enough for the wrecking company to allow their derricks to leave the Harbor of Refuge at Point Judith The two derricks hooked to wire slings around the stern took their maximum lift (250 tons), failed to budge the stern, were cast loose and hurried back to harbor The navy then undertook to salvage the vessel with its own facilities

Salvage operations were under the command of Admiral Plunkett, Commandant 3rd Naval District, at New York Captain E J King Commander Submarine Base, New London was in command of the salvage squadron, and was Officer in Charge of salvage operations Lieutenant Commander E Ellsberg Construction Corps, was Salvage Officer and directly in charge of all salvage work and diving operations

The salvage squadron consisted of the *U S S Falcon* a minesweeper specially fitted for diving

Photograph by International Newsreel

THE FATAL WOUND

In this photograph is shown the port side of the S-51 from about the angle at which the City of Rome *overtook and cut her down The swift inrush of water doomed the ship*

and salvage work equipped with high and low pressure air compressors, a recompression chamber wrecking pumps both steam and electrical and special bitts and chocks for handling weights The *U S S Vestal* a repair ship fitted with shops of every nature, manufactured all special equipment needed, berthed the extra personnel and acted as a portable breakwater Two seagoing tugs the *Sagamore* and the *Iuka*, were used for miscellaneous towing, but mostly as portable moorings

The *Falcon* planted seven heavy anchors around the wreck, each with a mooring buoy to which buoys the *Falcon* moored herself The *Vestal* normally anchored to windward to break the seas The *Sagamore* and the *Iuka* were normally anchored directly to windward and lines run to them from the *Falcon* to assist in holding in position In this manner and by this unprecedented use of ships as breakwaters and moorings, the *Falcon* was able to hold position and send down divers in rough weather, with wind blowing force 5 Otherwise diving days would have been so scarce that it is doubtful if anything could have been done The location was in the open sea out of sight of land and in a position notorious for continued bad weather This reputation was found to be fully justified

The first endeavor was to seal up undamaged interior compartments these being the control room, the engine room the motor room and the tiller room (these last two were handled as one) In each case the compartment was wholly isolated, the doors closed all valves closed and the compartment made an independent unit This involved an immense amount of difficult and dangerous work inside the boat on the part of the divers

Certain valves in the ventilation system required special treatment as they would not stay closed under an internal pressure To seal one of these valves a section of heavy copper pipe nine inches in diameter was unbolted under water by the divers and a blank flange put on To close off two others a 1½ inch hose was screwed into the valve body in each case and cement was run under pressure from the *Falcon* through 250 feet of hose into the valve A mixture of two parts of neat cement and one part of fresh water was used This experiment showed would flow and would safely harden under salt water The cementing operation worked very successfully The cement hardened quickly and the valves thereafter showed no leakage whatever

How Buoyancy Was Obtained

The hatches to each compartment, which were unable to resist internal pressure were removed and special salvage hatches installed by the divers These were held in place by a strongback designed to take the full internal pressure Each hatch was fitted with blowing connections for compressed air test connections to show the level of water in the compartment and a four inch spillpipe which extended to the bottom of the compartment and through which the water was expelled Each spill pipe had attached to its lower end a non return valve which prevented water from leaking back, and also acted as a relief valve for the air as the submarine rose to the surface

The salvage hatches weighed 700 pounds each Their installation by the divers was a difficult job It would have been an impossible one if the divers had not been provided with special davits booms and chain falls all made on the *Vestal* which were first secured to the *S 51* so as to plumb the hatch trunks The hatches were then lowered from the *Falcon* to the deck of the *S 51* where the divers hooked the hatches with chain falls from the special davits and thus handled them Aside from the four main compartments mentioned above, fourteen smaller compartments (ballast and fuel tanks et cetera) were sealed up and used for lifting

In many of the above tanks it was impossible to get at the interior valves or valve operating gear To utilize these tanks a hole was burned in the lowest point of the tank using the underwater torch designed by the writer An air hose was pushed through the hole so burned On turning on the air the water was forced out the same hole till the compartment was completely dry The hole later served as a vent for the escape of air as the vessel rose

and thus prevented disrupting the tank by subjecting it to undue internal pressures. In the manner stated above, a total buoyancy of 527 tons was obtained.

To provide the remainder of the buoyancy required as well as a margin for contingencies and a reserve, eight pontoons were provided, each with a net lift of 80 tons. These pontoons were steel cylinders, 32 feet long, 13 feet in diameter, sheathed outside with four inch yellow pine planks. Each pontoon was built like a section of a submarine, and was suitably stiffened with frames and girders, being designed to resist the full internal bursting pressure in case of a sudden rise to the surface. Through the vertical center of each compartment was run a 12 inch hawsepipe, riveted to a heavy casting, top and bottom, with eight internal brackets to distribute the load from the hawsepipe castings to the pontoon itself. Two and one half inch anchor chain, threaded through these hawsepipes, formed the cradle for the boat.

Cutting Tunnels With Water

Each pontoon was fitted with a six inch flood valve at the bottom of the vertical bulkhead on each end. This flood valve was operated by a rod reaching to the top of the pontoon, easily accessible to the diver. Alongside the flood valve was a six inch spring loaded relief valve, set to blow at an excess pressure of 10 pounds. On top of the pontoon, each compartment was fitted with a one inch connection for the blowing hose, located near the center bulkhead, and a three quarter inch vent connection located near the end bulkhead.

The buoyancy conditions required that six of the pontoons be located in the forward half of the boat where the internal buoyancy was slight, the other two pontoons were located at the stern.

At the extreme bow and stern the submarine was clear of the bottom. To get the chains through here, the divers first passed small manila reeving lines under, two lines being required for each pair of pontoons. To get these reeving lines under the S 51 for the other locations tunnels had to be dug. The tunnels were cut by washing away the clay with a stream of water from a firehose. On account of the depth and the hard bottom, no other means was available. It was found that 1½ inch hose with 60 pounds pressure was as much as a diver could hold. Under these conditions, it took two weeks work to run one tunnel under the submarine. The second tunnel was run much faster, as a new nozzle, which eliminated all pressure reactions, was utilized on this tunnel. With the new nozzle, a diver was easily able to manage a stream of water from a 2½ inch firehose under 200 pounds pressure and with the resulting stream of water, the second tunnel was cut through in two days.

The pontoons weighed 40 tons each, and were difficult to handle. If one broke free and fell on the submarine, it would crush it in. Such pontoons had never before been used except in shallow water, where they could easily be dropped into position. Here they required to be lowered to a considerable depth and placed exactly, especially in the forward half of the submarine, where a clearance of only eight feet could be allowed between pontoons in a fore and aft direction.

It was found that as a pontoon was flooded down enough so that it just submerged, it lost all longitudinal stability and invariably went down one end first if an attempt was made to lower it. Furthermore under the increasing pressure more and more water was forced through the flood valves into the pontoon which thereby increased in weight as it sank until it broke the lowering lines unless these were able to take the full weight of 40 tons.

To overcome these troubles it was found after some calculation and checking, that at a negative buoyancy of 10 tons, the internal water plane was sufficiently reduced so that the pontoon could be kept level, provided it was lowered evenly at both ends. To prevent any increase in weight during lowering, the pontoon was held just below the surface for a period long enough to flood it to a weight of ten tons, after which the air vents were closed off to prevent the escape of air and the flood valves were closed tightly. The pontoon was then lowered and acted as a fixed weight. To lower the pontoon, a manila line four inches in diameter was secured to each end of it by a pelican hook. These two lines were strong enough to take the full load, if it should accidentally be applied.

To get the 2½-inch chains, that passed below the hull, from pontoon to pontoon, into position, a manila line one half inch in diameter was first run under the submarine by the diver, both ends of the line being carried to the surface. A manila line 1½ inches in diameter was next hauled around by the *Falcon*, using the small line to haul. With the 1½ inch manila line as a hauling line, a one inch plow steel wire cable was hauled through. The wire cable had a breaking strain of about 35 tons. Using this to haul, a 2½ inch iron chain 90 feet long and weighing three tons, was lowered down on one side of the submarine and hauled under the keel until the chain was equalized on both sides.

With two chains in position, and a wire cable running to the surface from each end of each chain, the lowering of the pontoons was begun. Assuming that the starboard side pontoon was first lowered, the wire cables on that side were threaded through the two hawsepipes of the pontoon, and all four wire cables then hauled moderately taut to hold the chain cables vertical above the submarine. The slack in the manila lowering lines was taken in, and the pontoon vented and flooded until it submerged about four feet. Here it was held by the lowering lines until it weighed about 10 tons, when all vents and floods were closed. The pontoon was then lowered gradually and evenly until it had descended about 90 feet. At this depth it was held while two divers went down and landed on the pontoon. If the pontoon was in proper position (as it always proved to be), it was gradually lowered under the diver's direction until the chains showed through the hawsepipes. When sufficient chain showed through, the pontoon was held again. Here the diver burned a stud out of the chain link just above the hawsepipe (in some cases the stud was removed before lowering the chain) and inserted a 3¾ inch by 3¾ inch nickel steel bar 40 inches long which spanned the hawsepipe and passed the load from the chain to the pontoon. Over a span equal to that across the hawsepipe casting, 18 inches, one of these bars was successfully tested to a load of 235 tons before reaching its yield point.

Shift in Buoyancy Proved Troublesome

The diver locked this bar in position in the chain link by two long one half inch steel bolts which passed through holes in the nickel steel bar, one hole each side of the link.

Having secured his chains, the diver was lowered with the pontoon to the bottom where he opened the flood valves, let go the hauling wires on the chains, and cast off the lowering lines.

When the second pontoon of the pair was lowered, the process was varied, but limitations of space prevent a detailed description of the variation.

Having lowered and secured eight pontoons in the manner stated, they were leveled off in their afloat positions over the submarine and then lashed in place with one inch wire cables to prevent their slipping in the raising process.

As submarines have small longitudinal stability while submerged, a transfer of a ton or two of water from bow to stern will create a large change in trim. In this case, where the internal buoyancy of the pontoons could not be accurately checked while blowing, and considerable free water existed even in the compartments blown dry, it was out of the question to attempt to bring the submarine up both ends together, as one end was bound to become buoyant and rise before sufficient buoyancy could be given the other end. It was decided to bring the submarine up stern first, and all pontoon arrangements and lashings were put on in accordance with that design, together with taking advantage of all structural features of the submarine to prevent the pontoons slipping aft.

All work was completed June 21, 1926, the submarine and the pontoons were partly lightened in preparation for the final raising on June 22.

Why She Was Worth Salvaging

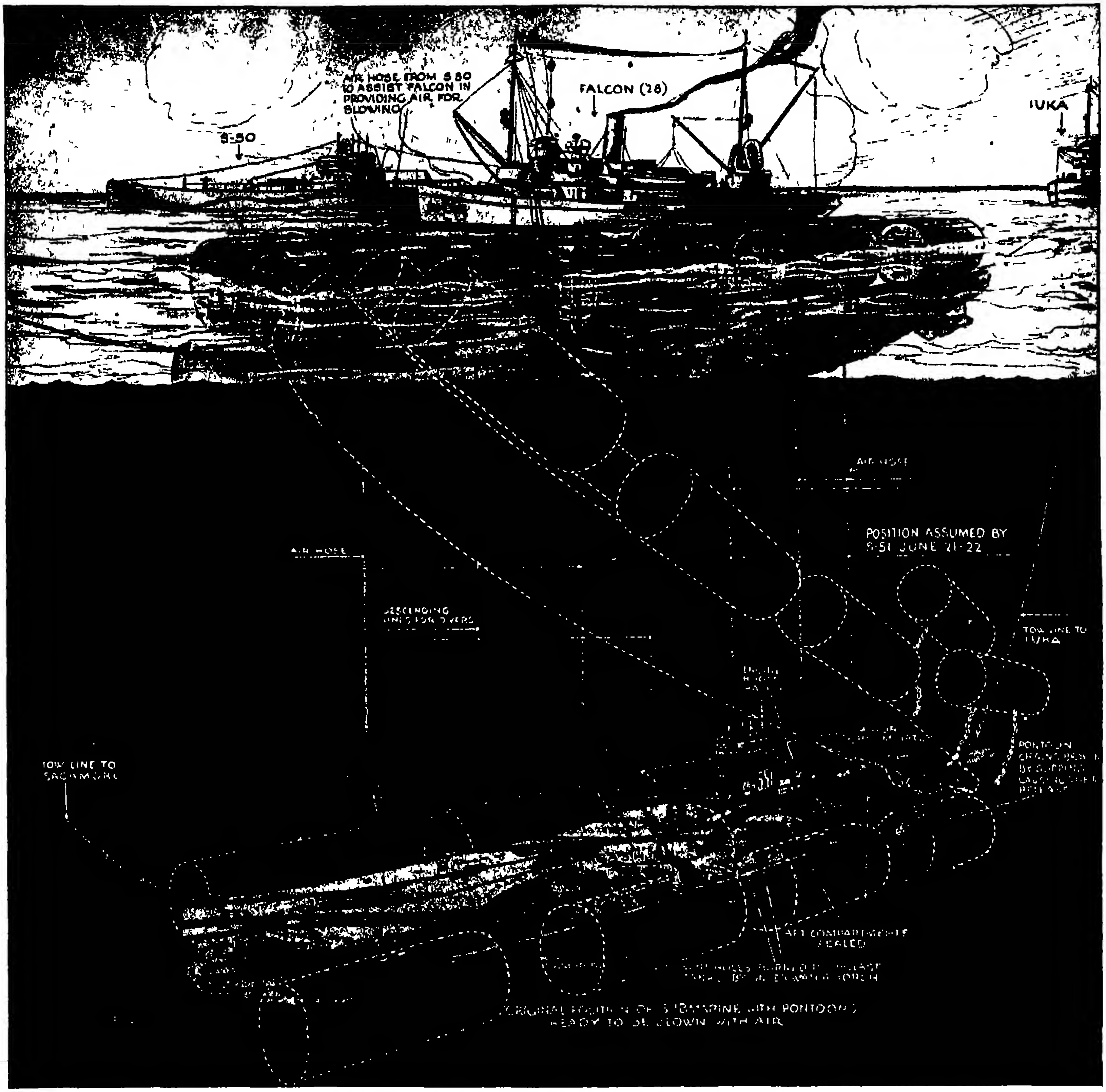
A storm broke on June 22 and prevented the raising attempt. The effect of the seas on the bottom apparently rocked the lightened submarine enough to break the bottom suction and tear the bow loose. While the *Falcon* was preparing to unmoor and run for shelter, the *S 51's* bow came up almost under her, and the first four pontoons showed above the surface. These pitched heavily in the storm and started to batter each other to pieces. Under these circumstances, an attempt was made to lift the *S-51's* stern and get away. However, when the stern pontoons had gained considerable buoyancy, their chains slipped forward a few feet and hit the vertical keel, where they snapped under the impact and freed the pontoons which floated up. As it was then impossible to lift the stern, the valves were opened on the pontoons at the surface and the bow sunk to avoid further damage from the storm. This was a hazardous undertaking, but the men tackled it willingly and the job was successfully carried through.

The damaged pontoons were raised, towed 15 miles to Point Judith, repaired and towed back to the S 51. In three successive days all six pontoons were again lowered and secured to the submarine.

All work was again completed about noon on July 5, 1926. At 12.17 P.M., the blowing process started, air being sent to the engine and the motor rooms first, then to the control room. Air was next admitted to the stern pair of pontoons, and at 2.06 P.M., while the stern pontoons were being blown, the stern rose. All air was then concentrated on the forward set of six pontoons. These rose at exactly 3 P.M., bringing up the bow.

The *S 51* was then started for New York, 150 miles away. The first 20 miles of the tow were through the open sea, in moderately rough weather, which caused no special trouble. Two tugs, the *Iuka* and the *Sagamore*, towed in tandem ahead, the *Falcon* towed about 150 feet astern of the *S 51* for the double purpose of serving as a jury rudder and to supply air. While no leaks developed, no chances were taken and the *Falcon* constantly kept pumping air to all compartments and all pontoons.

Long Island Sound was safely navigated, and the tow passed through Hell Gate at high water slack. The pilot endeavored to pass between Man of War Reef and Ferry Reef, instead of sticking to the main channel. As a consequence, the *S 51* was stranded on Man of War Reef at the top of the high tide. The impact broke the chains on the second pair of pontoons from the forward end, which pontoons floated up and drifted away. As the tide dropped, the position of the *S 51* became precarious, as she listed more and more, finally resting about 30 degrees to starboard. By resinking the other forward pontoons until they were out of sight below the water and shortening their chains, all the reserve buoyancy in them was brought into action. When the evening high tide arrived, these pontoons were



HOW THE NAVY PERFORMED ITS GREATEST FEAT OF SALVAGE

The S-51, weighing 1,200 tons, lay on the bottom in 132 feet of water, 14 miles from the nearest land and in very exposed and rough waters. Because of the gash in her side, the forward half of the boat could not be sealed. The after half was sealed and the water blown out. Eight pontoons, each with an 80 ton lift, brought the boat to the surface

again blown dry and just managed to float the *S-51* free of the reef. She arrived about 11 P.M. at the Navy Yard and was docked next day.

Here the vessel was examined. The bodies of eighteen members of the crew were removed. (Nine others had been previously removed by divers.) All bodies were promptly identified.

Both hull and machinery were found in good shape with no corrosion or electrolytic action from submersion.

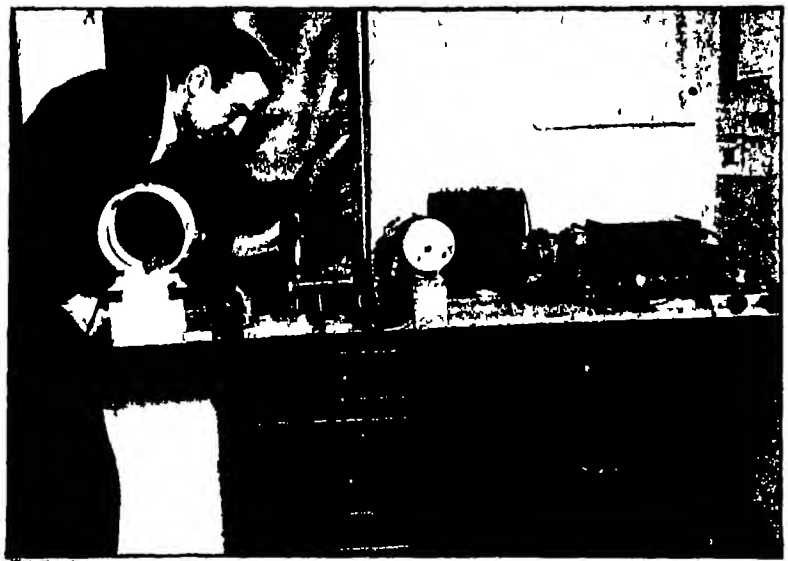
It is estimated that 600,000 dollars will be required to repair the hull and overhaul and replace the machinery, of which cost about two thirds is for the machinery. As the vessel cost nearly 3,000,000 dollars and is only three years old, reconditioning is obviously a good business proposition.

All told, 30 divers worked on the salvage job, although 24 was the maximum number present at one time, and only thirteen were in condition to work at the end. The others were incapacitated by "bends," pneumonia, and physical exhaustion. However, no diver was ever hurt by an accident. All the divers employed have now recovered and are in good health, although some can never dive again.

The operation was exclusively a navy undertaking, handled throughout by naval personnel, with all divers recruited from existing navy divers, or specially trained for this particular job by a diving class run last winter at the Brooklyn Navy Yard.

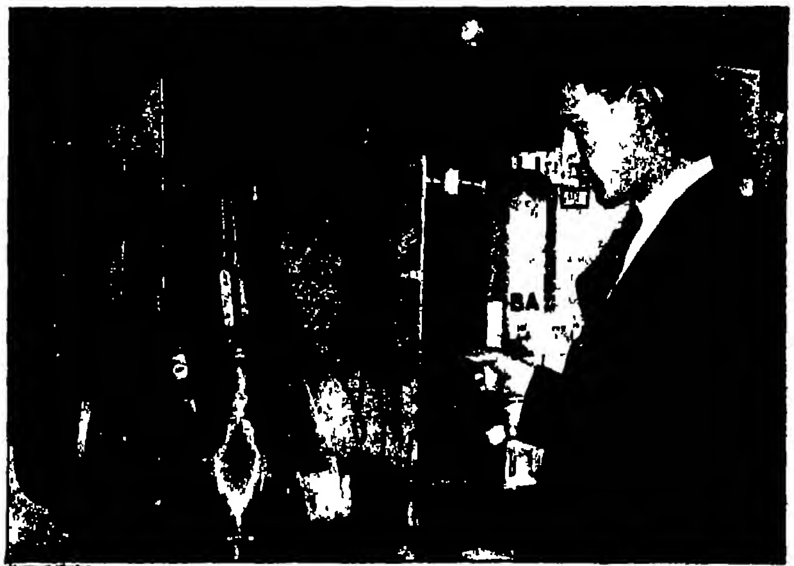
The job is an engineering undertaking is without precedent. It is the only occasion on which a submarine has been brought up by any nation from deep water in the open sea. This was also the only time in which submersible pontoons have been used in deep water, and, finally, the 150 mile tow of a submerged submarine in a pontoon cradle was unique both from a salvage and a seamanship point of view.

The engineering skill and the unconquerable spirit of the officers and men who made the job a success make this operation stand out as one of the brightest spots in the record of the Navy's peacetime activities.



STATION 2NZ's LONG-RANGE TRANSMITTER

Contact has been established between 21 different countries since the beginning of 1926 with this installation located in New York City. The operator communicated with the Byrd Polar Expedition for 17 days



AN ODDLY BUILT AMATEUR OUTFIT

Station 2BRB, Brooklyn, New York, uses a German tube. All of the transmitter parts are suspended from a stick. The owner is E. M. Glaser, former manager of the Hudson Division of the American Radio Relay League

Amateurs Find Marconi Was Right

Short-wave Possibilities and Beam Radio Were Outlined by Inventor in 1922

By Orrin E. Dunlap, Jr.

WHEN Guglielmo Marconi visited the United States in June 1922, he predicted that the advancement of science would be so rapid during the ten years to follow that the powerful transatlantic stations then in existence would become obsolete. He emphasized the fact that he believed the development of vacuum tubes for transmitting purposes would replace the more expensive and cumbersome high frequency alternators and that short wavelengths were a field of vast possibilities.

Senator Marconi said that he looked to America to aid in the development of short waves, a field which his engineers were delving into at that time. He explained that he had ceased his experiments with short waves twenty five years previous, because the demand for safety of human life at sea made it desirable to produce long-wave equipment which could be used for broadcasting at sea and for flashing SOS calls by stricken ships. He said that his investigations proved the value of waves from one to fifty meters in length and that he was perfecting a radio beam or "searchlight" method of communication.

AN AMATEUR TRANSMITTER

Wood is used for the panels of this 250-watt set. It is contended that maple is superior to composition panels for short-wave transmitter construction

Four years have passed since Marconi sailed out of New York Harbor on board his yacht *Elettra* bound for England. In the time that has elapsed since then, radio development has followed the trend Marconi outlined.

Short Waves Developed in Four Years

The British Imperial Empire is linked together by Marconi short-wave beam transmitters, the "baby" of which he demonstrated before a meeting of the Institute of Radio Engineers in 1922. Many of the high power, long-wave commercial and naval transmitters are supplemented by comparatively simple short-wave installations, and thousands of American amateurs, many of them boys in high school, operating home-made, short-wave transmitters in the attics of their homes, are talking around the world with less power than is required to operate an electric toaster or flatiron.

Four years ago many were amazed by Marconi's predictions regarding short waves, but his reputation as a conservative scientist led American amateurs to have faith in his statements. They knew that he had never made an announcement until he was absolutely sure and that he had never had to withdraw a statement as to his progress. When he first spanned the Atlantic with a radio signal on December 12, 1901, he did not issue a statement to the press until two days later.

American youth had confidence in Marconi and his remarks in 1922 spurred them to experiment with short waves, so that today the ether's channels below 80 meters are most popular in the amateur realm. Because it is more economical, commercial agencies are also adopting the short waves for long distance communication but the amateurs are credited as the pioneers of American short-wave wireless!

Amateur station 2NZ in New York City, owned and operated by E. S. Strout, Jr., is a typical example of amateur progress. This station has established two-way communication with twenty-one foreign countries since the beginning of 1926 and the log of the station reveals conversations with South Africa, Australia, Spain, the Argentine, Alaska, Malta, England, Norway, Italy and other countries thousands of miles away. It was 2NZ that talked with station KEGK, the *S. S. Chantier*, base ship of the Byrd Polar Expedition, for seventeen days, handling press and private messages. Most of the communication was done on 38 meters at night and up to the time the *Chantier* was 3,000 miles away from New York, good daylight transmission was obtained on 20 meters. South Africa also copied the signals from 2NZ on 20 meters during daylight hours.

Operator Strout explained that all results were obtained by using one UV-203-A 50-watt vacuum

ANOTHER AMATEUR'S SET

This photograph shows some of the apparatus at station 2EV, owned by J. D. Kilpatrick. Signals from here have been heard by other amateurs in many different countries

tube with an input of from 100 to 350 watts. The transmitting circuit is a tuned grid, tuned plate arrangement, which was found best of the self-excited circuits because of its steadiness on short waves. Proper tuning and a good filter for the plate supply give the transmitter a note practically the same as that of a crystal-controlled circuit.

A complete description of the transmitter and receiver used at 2NZ, together with the circuit of each, will be found in the Radio Notes section of this issue.

The antenna of 2NZ is a flat-top, inverted "L" type, forty feet high and ninety-five feet long over all. The antenna proper is forty-eight feet and the remainder forms the lead in. The counterpoise, built directly under the antenna, consists of three wires each ninety-five feet long and spread out in a fan shape, separated thirty feet at the far end.

Amateurs Have Aided Research

Aside from the amateurs signaling around the globe, they have contributed much to the reservoir of radio knowledge by learning the secrets and observing the vagaries of the ether. They have found out that short waves skip and jump around the earth and that the skip-effect is much more pronounced at night than in the daytime. For example, stations in New York are heard clearly in Australia without anyone in the United States being able to tune in the signals outside of an eight or ten-mile radius around the transmitter, the area of which is penetrated by a rapidly absorbed ground wave. The short waves are projected high into the upper atmosphere, probably about 100 miles above the surface of the earth, to be reflected back to the ground thousands of miles distant from their source.

Operators in the vicinity of Washington, D. C., report that it is a common experience, when working in the forty-meter band, to notice that, as the ionized layer of the earth's atmosphere rises to high altitudes after sunset, the skip distance is increased so that the New England short wave stations become gradually weaker as the night hours gain in darkness. At the same time, European stations working in this band and the mid-west and west-coast stations, as well as stations in New Zealand and Australia, are heard very loud. This effect is said to be caused by the sky-wave which passes through a medium not capable of absorbing the radio energy and therefore the waves actuated by a small amount of power travel over such long distances.

Another interesting observation that has been made in the short-wave field is that it is entirely possible

Wide World

AMATEUR SHORT-WAVE RECEIVER

E. S. Strout, Jr., of New York, contends that he was the first amateur to establish communication with the Byrd Polar Expedition. This is the receiving set that was used in performing the remarkable feat

to receive signals over a greater distance than one-half way around the earth. Knowing the properties of these waves, engineers have definitely stated that if Johannesburg, South Africa, hears a Pacific coast station at a time of day when there is nine hours of daylight between the transmitter and the African receiver, that a forty-meter wave could not possibly have traveled such a distance during daylight, therefore, it must have gone the other way around the globe, which would be 16,000 miles.

The development of the short waves for long-distance transmission has enlarged another of the amateur's fields. This is the one in which he "handles traffic." At any time, an amateur is only too glad to transmit a message gratis for anyone, upon request. By so using his apparatus under service conditions, he has a chance to make tests that will show him the value of his experimental work.

The amateur's method of sending a message, from New York City to Mexico City, for instance, is to listen in on his short-wave receiver and try to pick up the signals of some other amateur in or near Mexico City. Failing in this, he sends out the signal CQ, meaning that he wants to establish communication with someone and follows this with his own call-letters. In some cases he will insert the name of the city for which his message is destined. If luck favors him, he will establish contact with a station that is at least within local telephone call distance of the party to whom the message is addressed. The receiving operator will then forward the message.

Should it be found impossible to get in communication with a station close to the town of destination, the operator will send the message to some other station from whence it will be relayed on its way.

Today, with the record distances that can be covered with short waves, relays often include only three or four stations. In the days only four or five years ago, a coast-to-coast relay in the United States often required the services of a dozen or more transmitters. This, of course, was because of the relative inefficiency of the transmitters in use and also because the longer waves were not as good for long distance work as the short waves. A few years ago, it was necessary to use one half to one kilowatt of energy to transmit over a distance that today can be covered with one one-five hundredth of that power.

Type of Aerial Depends on Location

Amateur experimenters have found that in short wave transmission, placing of the aerial and run of the lead in is important. The free end of the wire, that is, the end opposite that where the lead in is attached, should be higher, if both ends cannot be of the same height. The aerial should be above surrounding buildings and trees and there must be no sharp bends in the lead in. The counterpoise should be about eight feet above the ground.

The advent of short waves increased the popularity of number 12 enameled copper wire instead of number 14 hard drawn copper wire which was used for amateur aerials for many years. The high-frequency currents travel mostly on the surface of the wire, and if oxide collects on the surface of the aerial, the resistance is increased and the efficiency of the system is reduced. The enamel coating prevents air from acting on the copper and causing corrosion.

The question as to whether a flat top or cage aerial is most efficient can only be decided for each particular location by experiment. Because operating conditions differ, the cage type is preferable where space is limited and amateurs have found that a cage about six inches in diameter is a satisfactory size. The lead in should be a small cage in order to minimize resistance.

It is best to use a minimum number of insulators in both aerial and counterpoise and for short-wave transmission and reception long thin insulators are superior to the short type. It is more efficient to put one insulator at each end of the aerial and counterpoise rather than at the end of each wire.

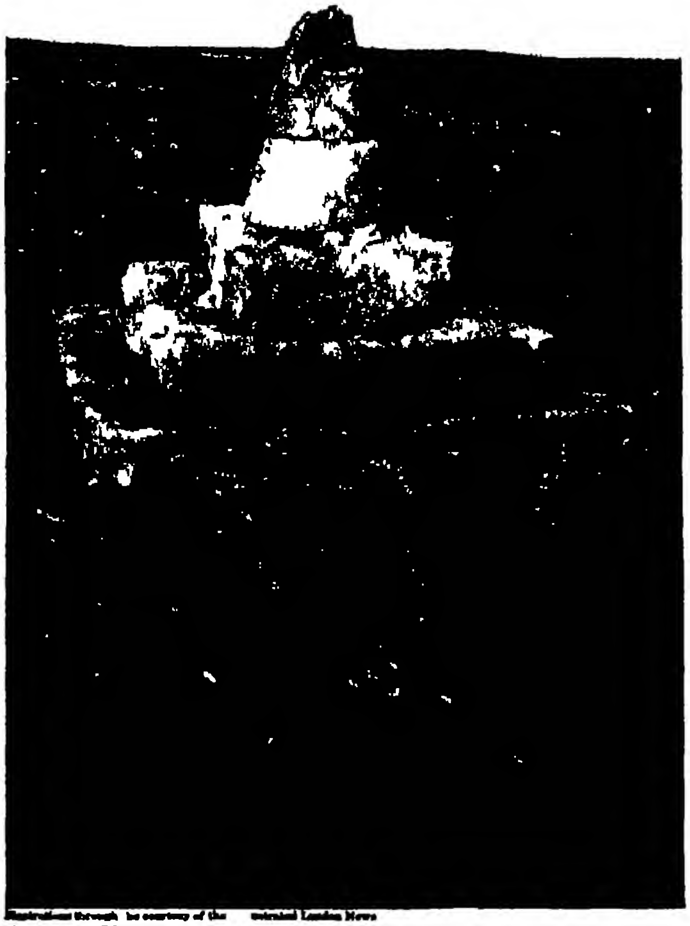
PUTTING AUSTRALIA ON THE RADIO MAP

This short-wave transmitter at 3EF, Melbourne, Australia, enables its owner, H. W. Maddick, to communicate around the world. The set has been heard in every state in the United States as well as in Sweden, Italy, China, Canada, Mexico and other countries

Herbert Photos

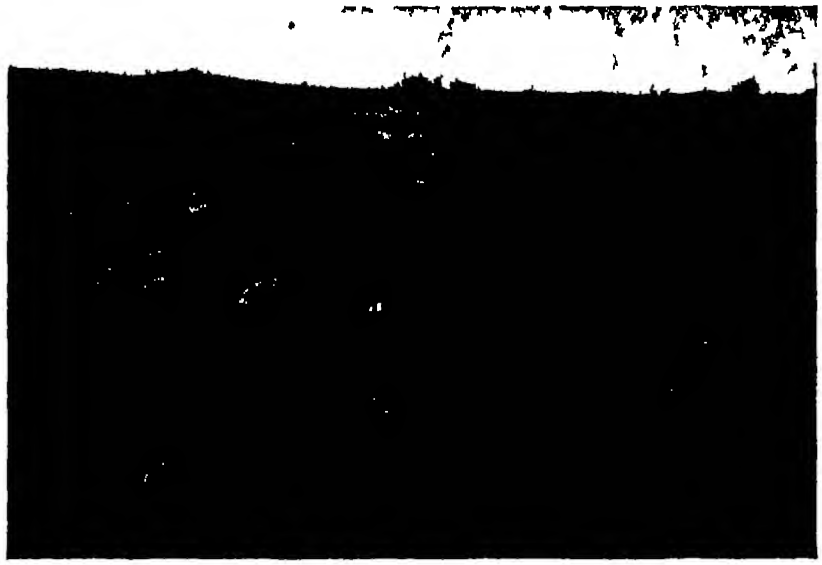
PRIZE TROPHIES OF AN AMATEUR

Cards reporting reception of the signals of station 2APV, New York, show that the transmitter has been heard in every part of the world. The large letters on the cards on the wall are the calls of stations that have heard the New Yorker and have reported



Illustrations through the courtesy of the Illustrated London News

A typical Phoenician tomb sunk in the desert region of Bu Kemmash the ancient Pisindon, in Tripolitania An ornamental cone, which has disappeared once topped the pedestal



A christian tomb constructed of gypsum and masonry, found near Tripoli, at Ain Zara (the ancient Abrotnon) It bears an inscription in Latin the Roman letters of which are practically as clear and legible today as ever

The site of a former Phoenician city, Sabrata (modern Zuagha), on the coast of Tripolitania The massive ruins which show on the left are those of the later Roman amphitheatre

Standing all down through the centuries—a headless statue of Aesculapius, found in its original position in the Roman baths of Leptis Magna

Important Discoveries Made by Archaeologists at Leptis Magna, in Tripolitania, the Italian Possession on the South Shore of the Mediterranean Sea

"The Italian Government is carrying out very brilliantly the task it has set itself since the occupation of Tripolitania and Cyrenaica—that of the thorough exploration of their great archaeological remains" writes Professor Federico Halbherr of Rome the well known archaeologist, in the *Illustrated London News* Few countries of the ancient world can boast such a wealth of monuments of the past as these two African provinces Four civilizations, from the prehistoric ages down to the Turkish Conquest in 1550 have left in as many superposed strata, the records of their rise, acme, and fall the early Libyan, the Greek and the Roman in Cyrenaica the Libyan again, the Phoenician and the Roman, in Tripolitania, and

A remarkably beautiful marble statue of Apollo, as the Pythian god of prophecy, found in the great Roman thermae or baths, at Leptis Magna (modern Lebda), in Tripolitania. Unfortunately the statue is headless, and the head was not found during the excavation. The Greek and, later, Roman god Apollo, among his other attributes, was supposed to be all seeing, and hence was the master of prophecy. He had many local titles

Lying prone as it was actually found in the thermae of Leptis Magna—Apollo as the god of music, or Apollo Citharoedus, the lyre-player. He holds a lyre in his left hand. Fortunately the head has not been lost, even in the fall which the statue must have suffered

over these, as the last, but not the least important, the Arabic in both those regions. The most recent discoveries have been made in Tripolitania. Since 1920, chiefly after the appointment of his Excellency Count Volpi as Governor of that province, very important and extensive excavations have been executed on many ancient sites of that territory, the most fruitful of which are those of Lebda—Leptis Magna—where splendid monuments of the Roman domination were lately brought to light. Leptis Magna, so called by the Romans to distinguish it from a minor Semitic settlement of the same name—Leptis Parva—near the Carthaginian frontier, was the leading city of the ancient Tripolitis, the other two being Oeea, the present Tripoli, and Sabrata, now Zuagha. Founded by the Sidonians on the coast between the promontories of Ras El Msel and Ras Serik, about seventy miles east of Tripoli, where the mouth of the Wady Lebda allowed the construction of a safe interior harbor, Leptis Magna grew, in progress of time to such importance and extent as to occupy a space about four miles in circuit. Its great beauty, the fertility of its surroundings, and the wealth of its inhabitants excited the admiration of the ancients. It was also a great emporium for trade. The city was almost entirely rebuilt after the Roman Conquest and especially in imperial times by Septimius Severus, who was a native of Leptis."

Hunting Fossil Insects

Even a Modest Expedition, When Properly Conducted, Can Bring Forth Much Knowledge of Scientific Value

By T. D. A. Cockerell

Naturalist, and Professor of Zoology at the University of Colorado

I WISH I could find a fossil dinosaur, fifty feet long, to astonish the world But that is a foolish wish, when I stop to think about it I could not possibly afford to have it dug out, shipped and prepared for exhibition, and if I could, where could I keep it? Dinosaurs, and mammoths, and the like, are not for ordinary folks with limited resources. So it is just as well to remember that size is not the important thing in science In recent years, it has been from the study of little things rather than big ones that advances have been made, and new fields have been opened

The study of fossil insects has several advantages over that of dinosaurs Very little apparatus is required, a pick and shovel, and a butcher knife will do very well The knife is used for splitting shale, by hitting the edges of the pieces The moral qualities necessary do not differ from those in other scientific pursuits, patience, perseverance, willingness to put up with some physical discomfort, and a capacity for being thankful for small mercies. The scientific results may be important It is laborious difficult and costly to obtain a single dinosaur or other great beast, which may or may not be new to science When collecting fossil insects, we usually obtain many kinds, including new genera and species A single day's collecting will often produce several forms entirely new to science, and frequently we find a specimen which carries the history of some insect group back several million years A johnny bag, instead of a two ton truck or a line of camels, will be the means of conveying the precious materials to our base

Fossil insects are not found everywhere, and it may seem to some a disadvantage that they often turn up in remote places. Actually, we esteem it an advantage, because it takes us off the beaten path, and affords an excuse for adventure It is easier to travel now than formerly, and while expeditions on the most modest scale cost money, they are possible for many who are in no sense wealthy People ask me why I do not have an automobile I reply that instead of spending time and money that way during the winter, I can go abroad in the summer, and really accomplish something Thus it has happened that my wife and I have not only worked at Florissant and in the Roan Mountains of Colorado, at Oeningen in Baden and Gurnet Bay in the Isle of Wight, but also in Siberia and the mountains of northern Argentina Just now, we talk about the possibility of visiting Turkestan

The Quest Leads to Siberia

Several years ago a Russian geologist named Kusnetzoff was investigating the Amagu region of Siberia, on the coast opposite the southern end of Sachalin Island On the bank of the small Kudia River he picked up a couple of fossil insects, which were eventually sent to the United States National Museum, and transmitted thence to me for study and description They proved to belong to the Tertiary epoch, and as nothing had been known concerning the Tertiary insects of this region, they were extremely interesting We decided to go to the locality, though we had been told that it would be impossible Through Dr Kryshtofovich of Vladivostok we obtained permission to enter the country, in spite of the fact that no official visa was possible from our government or the Japanese

As soon as the spring term of 1923 was over, we hastened to San Francisco to take the *Taiyo Maru* for Japan The California Academy of Sciences gave a dinner in honor of our expedition, and many interesting speeches were made by distinguished naturalists

The voyage across the Pacific was delightful, including a wonderful day at Honolulu, where we met all the resident entomologists and were most hospitably entertained by them On June 22 we reached Yokohama, and taking the night train, crossed Japan

Photograph by the author

A SCIENTIST'S HOME IN THE FIELD

Professor Cockerell's camp on the Kudia River, Siberia

to the port of Tsuruga, where the *Hozan Maru* stood ready to take us to Vladivostok Unforeseen circumstances caused a delay of a week at this point, but we were glad to have it so, as it gave us the opportunity to see the real Japan, out of the tourist routes The Japanese were very kind, and when we finally left for Siberia after a week among them, we were seen off by a delegation bearing presents.

It was not without some apprehension that we approached the Siberian shore, not knowing how we should be received. But when the Soviet official came on board, he passed our papers with great politeness, and there was Kryshtofovich awaiting us at the wharf Established at Vladivostok for a time, we had many interesting experiences. The governor of the Province received us in a very friendly manner, making a speech in Russian which was translated to us by an interpreter He also gave us his mandate, requiring every one to treat us well, a document which smoothed our way on various occasions.

The scientific men of Vladivostok arranged a banquet in our honor, and many kind speeches were made We were shown the various scientific and educational establishments, including the excellent Natural History Museum Through the kindness of Dr Kryshtofovich, we were able to secure the services of a guide and interpreter, Mr A I Lavrushin, whose services were invaluable

We were still far from the fossil bed, which is some four hundred miles up the coast from Vladivostok. There is no road, and the only way to reach the locality is by sea We accordingly took passage on the small coasting steamer *Aleut*, and after a few days found ourselves at the village of Amagu. The people here are Russians, belonging to an ancient sect commonly known as "Old Believers." They are isolated from the rest of the world—literally and absolutely so, during the long winter months—and carry on their affairs much as they have done for many years past. Yet they have a good farming country, and do not lack the necessities of life The government expects to establish schools, and already it was easy to see the influence of the long arm of the republic The head man was posting up government propaganda texts on his gate, one of them read "Without cooperation, not even a plow, with cooperation, a TRACTOR"

Far Afield in a Tent

My wife wrote her impressions in a letter at the time, as follows "At last all our cargo was landed, and a very primitive cart, the only sort known in this village, was brought, and the baggage put on board, while we trudged behind through deep mud to the village about a mile away We had "tenant" with the head man of the village, a big handsome man with a long reddish beard, really very grandly dressed in a pink blouse The house was a typical peasant house, with the big stove built in the side of the living room and a six by eight oven in the kitchen, with a smaller stove beside it for boiling, et cetera A shrine in the corner of each room held the sacred images, and guests upon entering the house made the holy signs even before greeting the people in the house.

"The building opened upon a large court or corral where pigs, chickens, geese, cats, dogs, cattle and horses wander around, making much dirt and constant noise. The two roomed house seemed small for its dozen or more inhabitants, but the people were most hospitable, and our guide thought it not practical to put up our tent The house was very dirty, and we feared the food would be quite impossible, but even the poorest Russians seem to understand the preparation of food, and our supper of cottage cheese covered with sour cream, wild strawberries preserved in honey with plenty of bread and butter and fried salmon was certainly a surprise At another meal we had batter boiled in milk, with butter, and I was allowed to make coffee. Their religion allows them to drink whiskey, but not to drink tea or coffee, although at our last breakfast our host surprised us by drinking coffee with us Our guide explained that even the Old Believers have had their revolution."

Our things were again loaded on a wagon, and our good host, Mr. Sharelpoff, brought them to a flowery meadow Here we decided to pitch our tent, by the cool waters of the Kudia River, in the shade of sweet smelling poplar trees, with splendid lilacs in bloom a few yards away This was inland from Amagu, but it was still possible to see the ocean from the crest of a nearby hill Larch trees (believed to be the lately described *Larix olgensis* of A Henry) were numerous, and species of maple (especially *Acer pictum* of Thunberg) grew near the tent. The only oak was the low-growing *Quercus*

mongolica of Fischer. The lime-tree or basswood, *Tilia amurensis*, was found in flower. Conspicuous among the herbaceous plants were splendid orange globe flowers, bright scarlet Lychnis, and many other beautiful things, making the place a botanical paradise. We heard the voice of the cuckoo, just as in England. Many new species of bees were caught, and the butterflies were numerous and splendid.

The fossil bed was not far from our tent. Unfortunately the soil above had fallen down, forming a talus slope which moved at the least disturbance. It was therefore difficult to get at the deposit, and when we did get at it, it was rather disappointing. Sometimes hours of digging would produce little of value, except fossil plants, which were numerous and varied. Nevertheless, when all our materials were gathered together, I had twenty-one new species of fossil insects to describe, some of them very beautifully spotted or banded.

Fossil Fish in Argentina

We considered the expedition quite successful, for although the fossils might not in themselves justify the trouble and expense, they had led us to a wonderful country, and caused us to have experiences not easily forgotten. Moreover, the discoveries among living insects and snails were many. On the way home, we came very near losing everything, and indeed our own lives, in the earthquake at Yokohama, but we reached security by a narrow margin, and eventually arrived in Colorado with the collections intact.

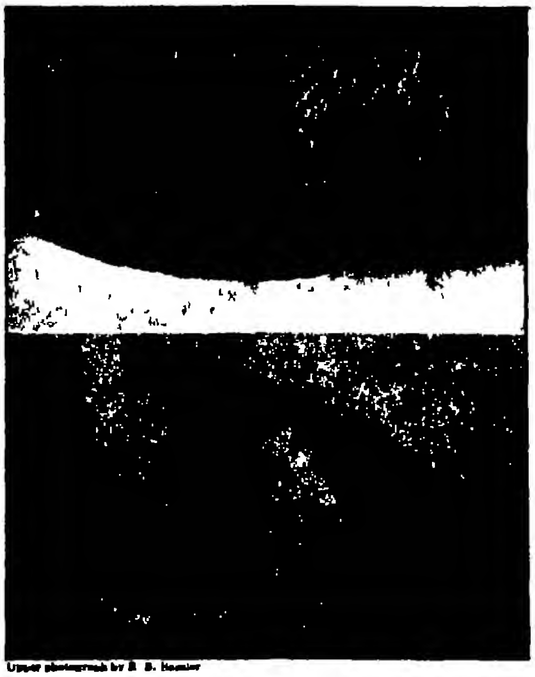
It is a far cry from the coast of Siberia to the mountains of northern Argentina, but Mr. G. L. Harrington, a geologist of the Standard Oil Company of Bolivia, had discovered a deposit of fossil insects in the Santa Barbara district of the Province of Jujuy, not far from the Bolivian border. Here again the fossils came to us through the United States National Museum. This was the first deposit of the kind to be found in the whole of South America, so there was nothing to do but go and investigate. We sailed on June 13, 1925, from New York for Buenos Aires, which we reached on July 4, after a very pleasant voyage in the good ship *Vestris*. Mr. Harrington was away in Bolivia, but Mrs. Harrington very kindly invited us to her home at Haedo, a suburb of Buenos Aires, where we spent a week getting ready for the expedition.

We were very fortunate in having Mr. Eugene Stebinger of the Standard Oil as a fellow passenger on the train northward, and getting from him much valuable advice, as well as the loan of a small waterproof tent. Eventually we found ourselves at San Pedro de Jujuy, on the Leach Brothers estate, where we enjoyed the hospitality of Mr. and Mrs. R. C. Anderson. This is a great sugar-cane country, and the way in which the industry has been developed by the five Leach brothers from England, in a period of about forty-five years, commands our admiration and respect. It would be hard to find a better example of the results of ability and industry, combined with moderation in living and kindness to the people employed.

We were still a long way from the fossil bed, and should have found it difficult to get there but for the kindness of Mr. Anderson, who had us taken in an automobile as far as the road went, and provided mules and a guide to take us along the trail. The car stopped in the midst of a beautiful forest, where Daniel Rios and his brother awaited us with the animals. Now began a journey up and down the steep hills, through fine country, but tiring to people who had not ridden for a long time. It was quite late when we reached Sunchal, which proved to consist of a single poor ranch.

Although we were nearly on the tropic, it was cold and misty, with condensed moisture dripping from the trees. We pitched our little tent, and cooked on an open fire outside. The next day we proceeded up the gulch, and soon found Mr. Harrington's locality. The fossils are in a peculiar green rock, which readily breaks into small blocks. There was no trouble in finding specimens, but nearly all were beetle wing-covers, which are not very satisfactory for classification or stratigraphy. Nevertheless, we got a fine little fish, representing a family of armored cat fishes not before found fossil, part of a male cricket, showing that in former times these animals sang as they do now, the forceps of an earwing, species of Hemiptera, and other things of interest. Some of the beetle elytra are elegantly marked with striking patterns.

The life of this region is of a semitropical type, with immense trees but no palms (except in the dry lowlands), many green parrots *(Amazona aestiva)* but so far as we could see, no monkeys. Great snails, common under the trees, proved to belong to a little known species not represented in North American collections. I was able later to publish the first good figures of this shell. A small butterfly, picked up in a chilled condition, turned out to be a Brazilian species new to Argentina, and the same was true of a conspicuous scale insect. The common shrubby groundsel growing by our tent was called *Senecio brasiliensis*.



Upper photograph by R. B. Hammer

TWO FOSSIL INSECTS

Upper *Earliest known fossil wasp, discovered in Colorado*
Below *A fossil butterfly found by Mrs Cockerell*

The Human Side of Science

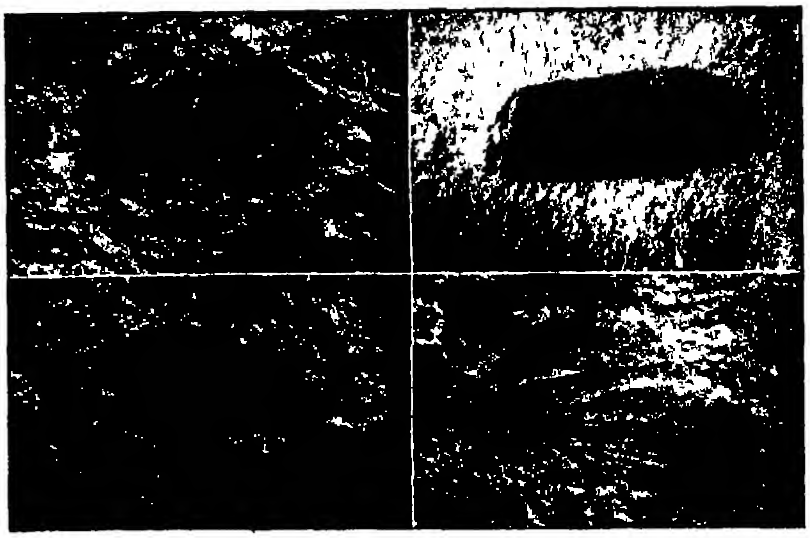
I have given only a very brief sketch of the Siberian and Argentine expeditions, but enough perhaps to show what we met with, and how it was possible to attain success. Nothing stands out more clearly than the kindness of the people with whom we had to deal, and among the various gains, we count most precious the friendship of those who aided us. Science, from its very nature, is international, and perhaps those who wish to promote international friendship cannot do better than facilitate scientific intercourse between nations. This is most effective when carried on privately, among individuals, rather than through formalities and ceremonial. Not only will scientific workers aid one another, but non-scientific people gladly lend their aid without expectation of recompense.

From the standpoint of the individuals participating in an expedition, whether in search of fossil insects or the Holy Grail, there is the immense satisfaction of having an objective to be attained, combined with the certainty of interesting experiences by the way. There is no better means of education, always provided that the prerequisite courses have been taken. The prerequisite courses in this case are those, formal or informal, which have stimulated a love of man and nature, a reasonable understanding of human and scientific problems, and a desire to learn.

Photograph by H. H. Hammer

A GROUP OF FOSSIL BEETLES

These interesting fossils, enlarged about seven times so as to present details, were located at Sunchal, Argentina, by G. L. Harrington, a geologist of Bolivia



FOSSIL INSECT WINGS FROM SIBERIA

These are enlarged about 2½ times Upper Left *Limnephilus resultus* Upper Right *Megacercopis optima.* Lower Left *Plecia refracta* Lower Right *Philagra kudiana*

Photographs by Gre... and by Brown ...rother

A CHAMPION AUTOMOBILE RACER AND THE SCENE OF HIS TRIUMPH

The photograph in the insert shows Frank Lockhart winner of the speed classic held this year on the Indianapolis race track

Guinea Pigs of Motordom!

How Automobile Racing Gives Us a Longer Ride for Our Money

By Nell Ray Clarke

NO one would think of the automobile race track as a practical laboratory yet that is what it has become It is in reality a proving ground of ideas out of which the best are sorted for future use possibly by the general motoring public

It is a dangerous pastime this furious clocking off of more than a mile and a half a minute There are thousands of dangers—that of speed of a collision of skidding of some broken part of the machine causing it to get beyond the control of the driver Even a sparrow flying across the track has been known to injure seriously the eye of a driver There is the danger from fire and from the bursting of a gasoline tank which invariably burns the driver Someone has called the drivers the *guinea pigs of motordom* meaning that they are used in the automotive world just as are guinea pigs in research laboratories for trying out experiments

Motors Smaller Than Ever

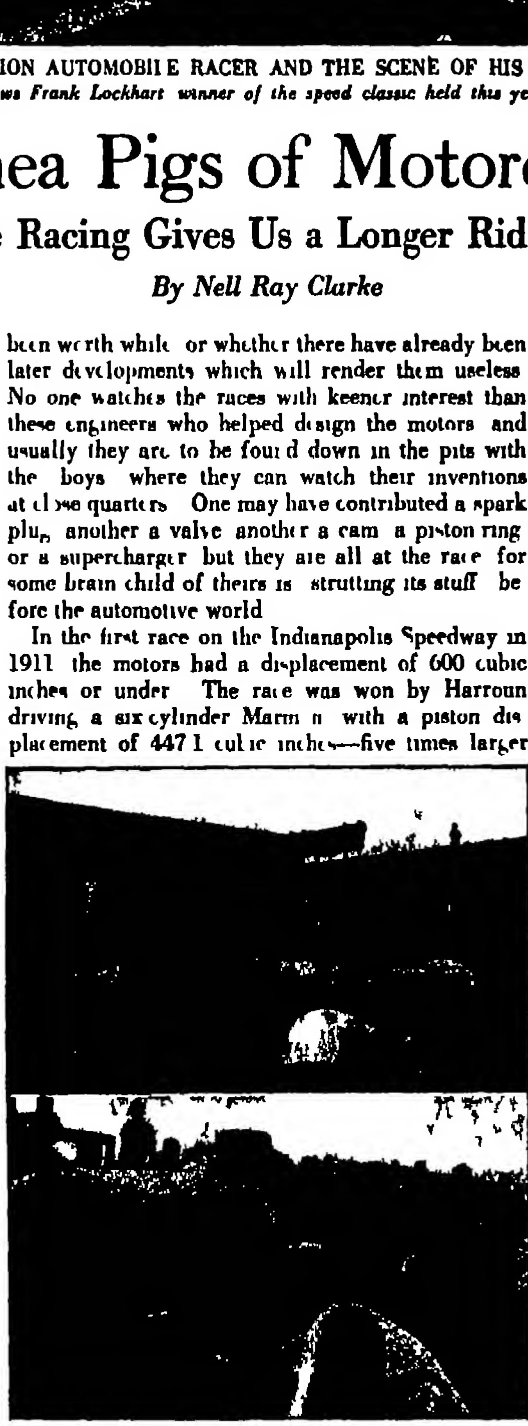
Racing is a test of speed but still more important each year is endurance—endurance of car and driver It is a test of valves valve springs crankshafts oiling systems, tires ignition spark plugs gasoline and other mechanical and technical details It is also a test of a man's capacity for standing physical punishment over a track that hurls him continuously for five or six hours of his nerve his courage and of the response of his muscles to the will of his brain

The cars are stripped for action They are little and lithe with canoe like bodies They are virtually motors on wheels Their steel or aluminum bodies are somewhat longer than a man is tall stream lined to offer little or no resistance to the wind and so narrow that the driver figuratively gets into his seat with the aid of a shoehorn The dash board in front of him is hardly wider than the rim of his steering wheel and oftentimes a portion of this rim is cut out to enable him to squeeze into the seat

Primarily the race is a test of the engineers the men whose ideas are being tried out It will tell each whether his year of research and labor have been worth while or whether there have already been later developments which will render them useless No one watches the races with keener interest than these engineers who helped design the motors and usually they are to be found down in the pits with the boys where they can watch their inventions at close quarters One may have contributed a spark plug another a valve another a cam a piston ring or a supercharger but they are all at the race for some brain child of theirs is strutting its stuff before the automotive world

In the first race on the Indianapolis Speedway in 1911 the motors had a displacement of 600 cubic inches or under The race was won by Harroun driving a six cylinder Marmon with a piston displacement of 447 1 cubic inches—five times larger than the motor which finished first in the 1926 race —and the average speed was only 74.59 miles an hour In those days some of the pistons measured from 4½ to 7 inches high and were about the size of a quart cup Today the pistons are about the size of milady's box of rouge

The motors this year are about half as large as a Ford motor 91½ cubic inches—smaller than motors have ever been in the history of racing They are there with the horsepower however The winner of the race Frank Lockhart a young Pacific coast Lochinvar by driving his car at a speed of 115 48 miles an hour, established a new track record for a single lap The former record of 114 28 miles an hour established last year by Peter de Paolo was made in a car with a motor one third larger than those in the cars entered in the race this year



ADDING THE FINISHING TOUCHES

Two ... of Peter de Paola's eight cylinder Duesenberg racer ... h was still being assembled when the other cars were qualifying for the race and ... although still stiff finished in fifth place

Speed Steadily Increases

The average speed of 94 68 miles an hour maintained by the winner of the race this year is not as high as the average speed of the winner of last year's race—101 13 miles an hour Attention should be called to the fact, however, that the motors were brand new and almost in an experimental stage, and it is believed by experts who watched their performance that they give promise of surpassing in speed and performance, when they have been perfected, the type used during the three preceding years

"During the war," said one authority, (Fred Duesenburg), "the Government asked automotive engineers for a powerful engine, so we got together and pooled all our ideas By selecting the best we could offer, we finally developed an engine of about 900 cubic inches which developed 203 horsepower We thought we had done a pretty good job Today, just eight years later we have produced a motor one-tenth that size which develops almost the same horse power"

To encourage just this kind of efficiency, as well as to decrease speed and consequently the danger to human life attendant upon the race, track officials every two or three years have decreased the piston displacement of the motors to be entered. In spite

of that fact, however, the speed made on the track has steadily increased

Another authority, Harry Miller, furnished these specifications for the details of his motors and the other entries vary little therefrom:

The engines have eight cylinders in a line, arranged in two blocks of four. The combustion chamber is semispherical. There are two valves to each cylinder, two overhead camshafts, and spur gear drives. The crankshaft is counterbalanced, and there are five main bearings. The bore is 2 3/16 inches, the stroke three inches, and the piston displacement is 90.2 cubic inches. The weight of the car complete is 1,400 pounds, the length is 149 inches, the wheel base 100 inches, and the tread 52 inches. It stands 37 inches above the ground at the radiator, the height at the seat is 20 inches and the body is 18 inches wide. The car carries 4½ gallons of water, five gallons of oil, and 25 gallons of gasoline.

In the main features, the racing machine is not radically different from the passenger car. The engine is of the same general type, it has the same type of transmission, the same rear axle and differential, and the gear ratio, which ordinarily is associated in the lay mind with the speed which a car can make, is not essentially different. In order to permit the gas to pass more quickly into the cylinders the valves have a larger area in proportion to cylinder volume. Of course, it goes without saying that most of the parts have been made with greater care than is exercised for the stock jobs and that there is greater nicety in fitting the parts together. The supercharger "peps" up the speed about half again what it would be without that very recent addition and it pushes the engine speed up to between 6,000 and 7,000 revolutions per minute.

The wheel diameter is 30 inches. The treads of the balloon type tires are smooth and very thin, and the rubber along the sides of the tires is so thin that you can easily see the cords through it. The air pressure used is 35 pounds. The chief improvement in the tires for racing cars during the years has consisted in getting substances to harden the rubber so that it can stand the abrasion, to the sacrifice of other factors which are desirable in tires designed for long use. There was less tire trouble during this year's race than ever before. In the race the tires get much too hot to touch—"plenty hot" as

Photograph by U[illegible]

A RACING CAR DESIGNER

This photograph shows Mr. Schmidt, designer of the Schmidt Specials, with one of his extremely p[illegible]ful yet small bore racing car motors

one mechanic expressed it, and sometimes they become hot enough during the grind to devulcanize the rubber.

Regardless of their names, most of the cars entered in this year's race were the creations of Harry Miller, two of them being front wheel drives. Some manufacturers made adaptations of the Miller motor by substituting valves or other devices of their own creation, and then rechristened the cars. The remaining cars in the race consisted of two Duesenburgs, one of which was the much discussed two cycle job, a dolled up front drive Ford, and three Schmidt Specials, which were of French make using single sleeve valves in the motors.

Fred Duesenburg has pioneered for the American motor car in the straight eight motor, the supercharger idea, and the hydraulic four wheel brake. The straight eight motor and the hydraulic four wheel brake have come into ordinary use. It is said that the supercharger will follow.

450 Miles on a Gallon of Gasoline!

This year Mr. Duesenburg tried out the two cycle engine. The idea is not a new one, for Bill Turner finished in a two cycle Amplex in eighth place in 1911. The new two cycle model is not yet considered practical, but this engine was acquitting itself with credit until a rear tire went soft and it skidded and hit the wall, putting it out of the race due to a bent rear axle.

The supercharger on the Duesenburg cars is a device resembling a great snail shell attached to the side of the motor, which sends the fuel flying into the motor to develop additional power for more rapid speeds. This is really a centrifugal pump rotating at six to seven times crankshaft speed or up to 40,000 revolutions per minute! It pushes the gaseous mixture of fuel and air into the intake manifold under a pressure of about ten pounds per square inch above atmospheric pressure.

The front wheel drive Millers, another innovation this year, are not entirely new, for Walter Christie drove a car with a motor geared to the front wheels before the days when auto racing fixed Indianapolis on the map. The advantage of the front wheel drive is that it eliminates the danger of skidding. The back of the car simply trails after the front wheels. It also enables the designer to reduce the frontal area which is exposed to wind resistance by seating the driver much lower in the car, as well as to lower the center of gravity. In the average car the back wheels push the front of the car about—a sort of cart before the horse arrangement.

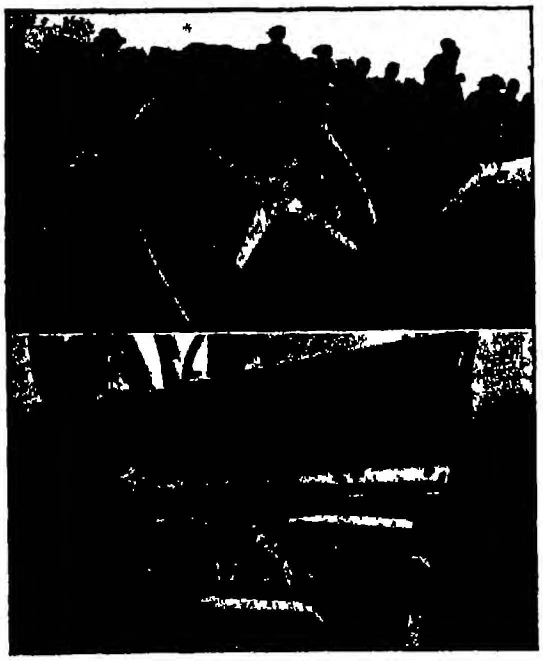
In the recent Indianapolis event the front wheel drive cars, although they did not finish the race, could take the curves at the same rate of speed that they could make on the straightaway, whereas the rear wheel drives had to slow down.

It is evident that the general tendency through the years in motor development for racing cars has been toward an engine of small piston displacement, developing higher and higher power. What has been learned in racing has been applied to the passenger car and each year or two the motors in our passenger cars have grown smaller and smaller, but our speed has increased. In ordinary parlance, that means a longer ride for our money, or more miles to the gallon. Mr. C. F. Kettering, perhaps the foremost automotive engineer in America, has said that there is enough power in a gallon of gasoline, if it were used efficiently, to drive a Ford from Dayton to Detroit, a distance of 450 miles. There is yet something for these engineers to work for. Real fuel economy is the desire of all automobile drivers.

Those in the know believe that the engines in our passenger cars are going to grow smaller in the future and that in a few years we will be getting 50 miles to the gallon readily, without any sacrifice of speed. They point to the number of small cars now in use in Europe which boast that mileage. So highly are the engineering features of some of these motors being developed, that one automobile engine, manufactured in Italy, is now said to be able to make from 7,000 to 8,000 revolutions a minute.

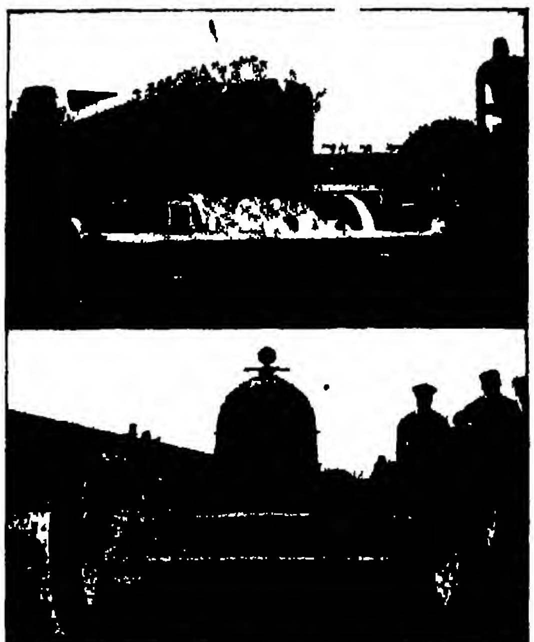
At least it is safe to predict that whatever economies of construction or factors of safety are found practicable in racing cars will ultimately come to the joy riding public. The man whose motor failed him on the race track has perhaps contributed more to you and to me than the man who won the race. Through these very failures automotive engineers are learning the weaknesses and the flaws in their creations. That knowledge is power in their hands to better their output in the future and to aid the pleasure car driver.

Defects in our spoken language have caused the United States Navy to develop a system of communication that is not easily misunderstood. It will be described in our November issue.



TWO RACING SPECIALTIES

Top: The steering wheel is cut away so as to allow room for the driver. Below: A Duesenberg motor equipped with a supercharger shown in the center of the motor



Top [illegible]

EXAMPLES OF FRONT END DRIVES

The photograph at the top shows a Miller Special that held the lead for 100 miles. At the [illegible] Ford with the motor geared to the front wheels

Clean Comfort in the Home

How the Coal-burning Furnace May Be Converted to An Oil-burning Type, and the Results of the Change

By Louis S Treadwell

THE difficulties of the owner of a coal burning furnace are many. It is not only necessary to purchase a large quantity of fuel usually at a time when the household finances are rather low but it is also necessary to periodically transport this fuel from the storage bin to the furnace by hand and to otherwise take care of the heater. The shaking down and removal of ashes is a dusty job and one that the average house owner would be only too glad to get away from. These and other objections to the use of coal as a house heating fuel have led many to find a way out of the difficulty.

At the present day house heating by means of oil seems to be the solution to the problem. Oil holds many advantages. It is easy to obtain and to store and a well designed and properly constructed oil burner will operate throughout an entire cold season without any attention whatsoever on the part of the owner.

How to Select an Oil Burner

When the house owner is considering the installation of some new type of heater in his present coal burning furnace there are two questions that are uppermost in his mind. The first is "How does the cost of oil compare with coal?" The second question is "What is the best oil heating device to install?"

A consideration of the cost of oil burners and of their installations as well as of the accessories necessary brings us to the conclusion that at the present time, there is but little saving in cash that can be effected. However there are many advantages on the side of the oil burner that would tend to overcome even an increased cost.

A fair comparison of the cost of a good grade of fuel oil as against coal can be obtained if we consider that 100 to 125 gallons efficiently burned will provide the same amount of heat as one ton of a good grade of hard coal. At 10 cents per gallon or less according to the market it is obvious that there will be an actual saving of from 25 to 40 per cent in favor of the oil. There is, however, the additional cost of the pilot light, plus that of the electric current for the automatic control and motor. For the pilot light, the cost of gas will average 75 cents to $1.25 per month, and for electricity, $1.25 to $2.00 per month, making a total of from $2.00 to $3.25 per month. Moreover, heat will probably be used at least a month longer each year because of the automatic functioning of an oil system on chilly mornings and evenings when building a coal fire would be too much trouble. It is this last consideration however that makes an oil heated furnace desirable for it provides an even temperature in the house at all times independent of human effort.

> **Solving the Heating Problem**
>
> **It is but human to want the greatest comfort in one's home, and so the problem of heating the home in an efficient and healthful manner is one that occupies a great deal of attention. The market has recently been flooded with numerous types of oil-burning devices that are designed to be used in standard coal-burning furnaces. The interest in these has been so great that we have made an extensive survey of the situation and this has led to the conclusions that are put forth in the accompanying article. In the selection of a home-heating plant of the oil-burning type, the average person should not feel competent to judge for himself as to the one to buy. This important detail should be left to some one who is constantly in touch with the oil-burner manufacturing field. If any reader who desires to install a new heating system will follow this article, we are quite sure that he will have little or no trouble with an oil-burning plant. —*The Editor***

The cost of a good installation including a storage tank of about 275 gallons capacity runs from 350 to 550 dollars or even higher. Although there are cheaper devices advertised it is usually found that either they are not as dependable or that the cost of the extras which are not included in the advertised price for the mechanism when totaled will raise the complete cost practically up to these figures.

It is obviously impossible for us to advise each individual reader as to the type of oil heating device that is to be installed. We have illustrated on these pages several types of oil burners that can be installed in standard coal burning furnaces. Probably the best thing for a furnace owner to do in order to determine the type of oil heater that he should buy is to communicate with the manufacturer of the coal burning furnace that he has on hand. They will probably be able to tell him just what type of oil burner will be most satisfactory for use in connection with that heater. Another good plan is to get in touch with a company of heating engineers. They can act in the capacity of consultants and also as an intermediary between the consumer and oil burner manufacturer. This latter course will not be any more expensive in the end because the company of heating engineers will get their commission from the manufacturer of the oil burner that you purchase. Furthermore, their experience with all types of coal burning furnaces and with the installation of oil heaters therein will enable them to advise the consumer in the most intelligent manner possible.

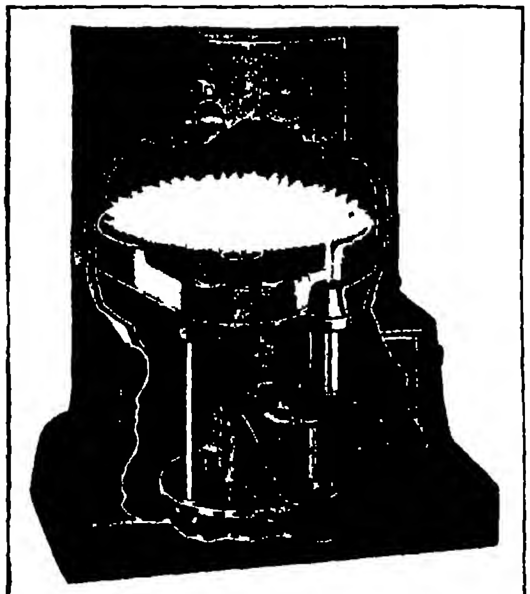
In general, there are two types of oil burners on the market today. In one type, the oil is thoroughly atomized and mixed with air. This process is carried through by means of an electrically driven pump. The other general type uses gravity feed. It is interesting to know that the United States Department of Agriculture has carried on numerous tests with these two types of furnaces and the results of these are expressed in the following paragraphs, quoted from a recent report of that department.

Good Combustion Essential

"The tests conducted show that the atomizing type of burner is higher in efficiency and has less tendency to soot than the gravity type. Fuel oil will not burn readily when a flame is applied to its surface and hence the oil must be prepared for combustion. In the gravity feed type some device such as a hot plate is necessary for volatilizing the oil. In some types the plate is heated to get the fire started after which the heat of the oil burning on the plate is relied upon to keep it hot.

"Air is generally brought into the furnace by the natural draft produced by the chimney. Ingenious methods have been used to induce an intimate mingling of this air with the vaporized fuel. In general good combustion is not secured by this means. While the principle seems simple enough the fuel and air are not mixed with sufficient thoroughness to produce a good clean flame. In the cheapest burners of this class the burner is started and controlled by hand.

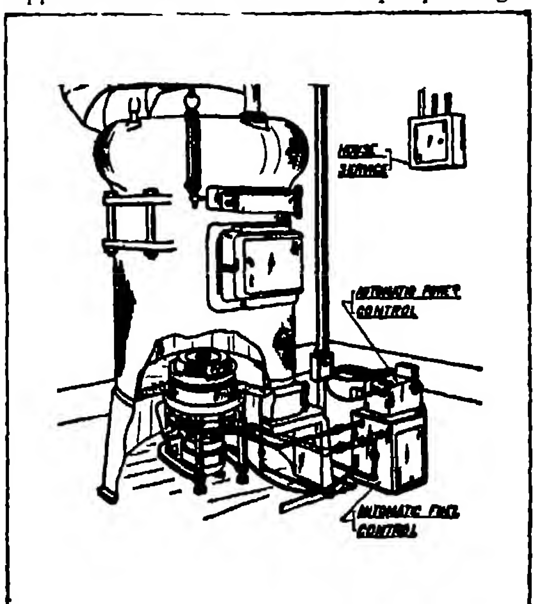
The atomizing type of burner includes the spray type and those which break up the oil by forcing it under pressure through a small opening air being supplied to the flame by a blower or pump arranged



Courtesy of [illegible] Oil Heater Co.

SELF CONTAINED

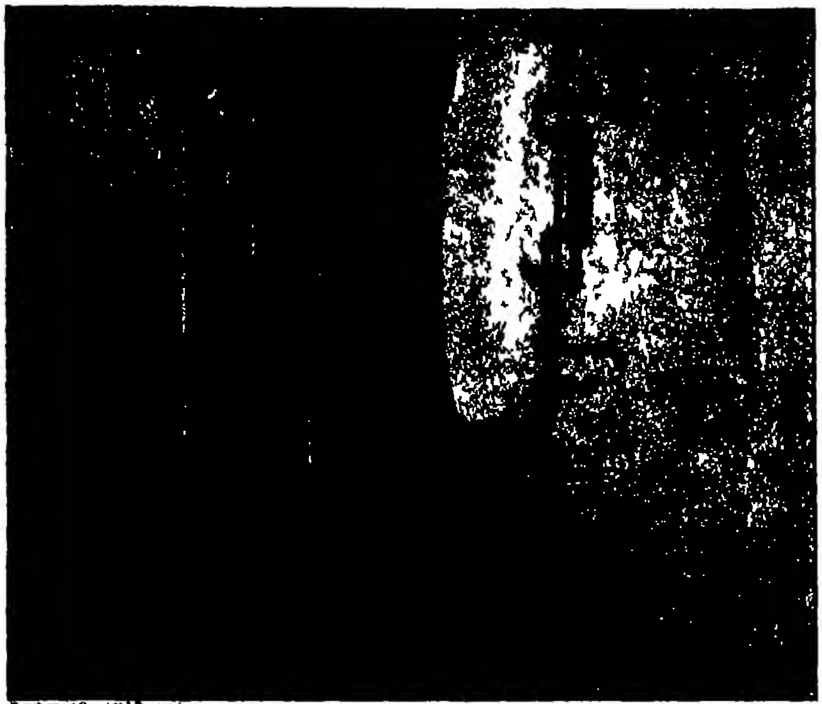
Here the mechanism is placed in the ash pit. Only the carburetor is outside the heater. The mechanism is supported by springs to deaden vibration and noise



Courtesy of [illegible] Corp.

AN EFFICIENT TYPE

After it has been emulsified oil is thrown from a spinning disk through peripheral breakers. Thus a swirling motion is imparted to the mixed gases of combustion



Courtesy of [illegible]

A COMPROMISE

In this type of burner no special setting is required. The existing grate and fire box are lined with fire brick giving a refractory surface which adds volatilization of the oil

Courtesy of [illegible]

ONE METHOD

A [illegible] the [illegible] flame

so that it can be regulated. The spray type of burner consists principally of an air and oil nozzle arranged so that air from a motor driven compressor blows directly over the oil nozzle, creating a partial vacuum. This draws from the oil supply a finely divided oil spray in somewhat the same manner as gas is supplied to the cylinders by the carburetor of an automobile. The rate of feed is controlled by the air pressure and nozzle opening. Automatic control with a thermostat is generally used.

"For the atomizing type, gas or electricity or possibly both, are required for ignition and electricity is used to operate the motor which drives the blower and oil pump unit.

"Gravity type burners are installed at a cost as low as 30 dollars, but in addition to the objection of sooting and inefficient combustion, they require a high grade fuel costing more per gallon and containing fewer heat units per gallon than lower grade oils."

Cleanliness an Attractive Feature

After oil heating has been installed, the furnace man—be he owner or hired—is done away with and the idiosyncrasies due to individual methods of firing are eliminated. It is only necessary to start the oil heater in the fall, to set the automatic temperature regulator at the desired point and forget about the furnace for the rest of the season.

The fuel oil that is employed in connection with an oil burner is stored in a tank buried in the ground outside of the house. A filler pipe for this tank extends out to the curb. In order to get a good idea of the comparison between coal and oil burning facilities, form the two mental pictures described in the following sentences. A truck load of coal is driven up to the side of a house, the coal chute put in position and bag after bag of coal rattles down the chute. This nerve racking noise continues for possibly half an hour. After the coal man drives away, small pieces of coal are found within a radius of five or ten feet around the window or other opening through which the coal was introduced. These must all be picked up in order to keep the yard looking neat. After the furnace has been in operation for some time, the ash pile grows steadily higher and higher. An ash man comes and takes it away. He charges for his labor. The dust that is necessarily stirred up during his work is most annoying as it will sift into the house and settle everywhere that it is not wanted.

The other picture is far simpler. An oil tank truck draws up to the curb and places a delivery pipe in the tube that connects with the home oil tank. In a few moments, a hundred or more gallons of oil have been delivered without noise, dirt or trouble and the tank drives away. This is the last that is seen of the fuel, either in its original form or in the form of a burned residue. There are no ashes to be removed.

In one of the types of burners that we illustrate an emulsified mixture of air and oil is shot downward toward a surface of heated bricks that have been placed over the old grate and around the fire box. The reflected heat from these bricks reacts to produce more efficient combustion. With this type of burner, the bricks can be removed from the fire pit and the furnace used for coal burning in case this should be necessary, due to a temporary failure of the electrical supply to the burner mechanism.

Another type shown is that in which practically the entire mechanism is set up in the ash pit with the ordinary coal grates removed. Oil mixed with air is thrown from revolving or stationary peripheral orifices through breakers, becomes volatilized and is burned like a gas. The mechanical mixture of oil and air is sometimes agitated further and projected toward a hot iron surface or a glowing refractory substance which aids more complete combustion. A pilot light fires the oil and a thermostat responsive to the heat of the rooms controls the speed of the actuating motor.

A combination of the two types of burners described above is also illustrated. In this very efficient unit, the actuating mechanism is placed outside of the heater and a burner in the pit causes the combustion of the oil. This particular system does away with the necessity of having brick linings or specially constructed refractory baffles.

There is one other feature to be found in connection with oil heating that we must not fail to stress. It is one that will appeal to all as it enables the home owner to obtain more space for living or recreational purposes. When a coal burning furnace is used, a large part of the cellar is taken up by the coal storage bins. The ash receptacles that are a necessary part of the furnace equipment also take up space. The very nature of the coal burning furnace eliminates the value of the remainder of the cellar for anything else than for the storage of materials that are not damaged by dust and dirt.

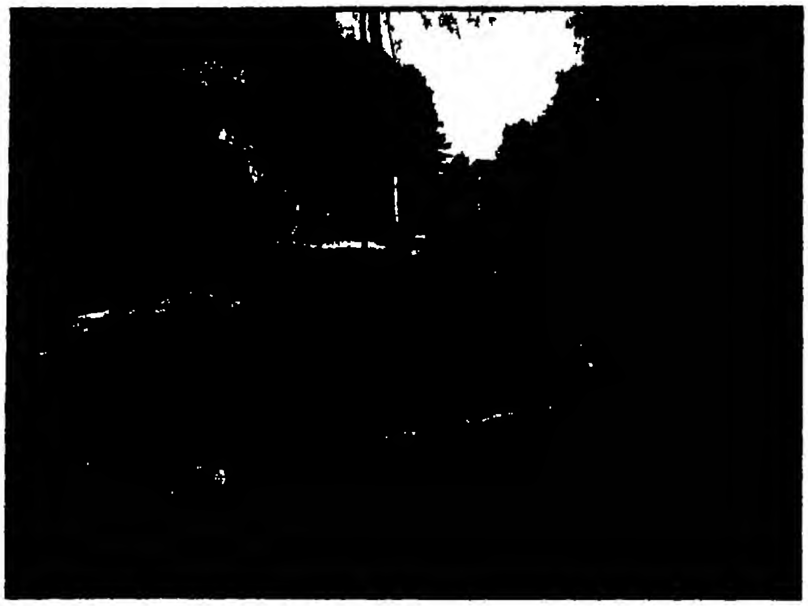
All this is not the case when oil heating is used. Then the heater and its apparatus takes up only a very small part of the cellar. The remainder at once becomes available for other purposes and the average home owner, after installing oil heat, usually takes advantage of this at once. It is not infrequent to find that a billiard or card room has been built in the place that formerly was occupied by the coal bins. A very convenient laundry also can be located in the cellar. Play rooms for the children and other space saving ideas will present themselves.

Even Temperature Promotes Health

It must not be thought that the construction of such rooms in a basement will be highly expensive. The contrary is true. Plaster board can be used and the walls can be papered or painted at a low cost. In many cases the man of the family will take delight in the work entailed in building these rooms.

With coal burning furnaces of any kind, regardless of whether they be of the hot air, hot water or steam type, the fumes from the burning coal are bound to get into the house and to cause a disagreeable settlement of dust. This is not only bad from an esthetic standpoint but the effects of the fumes on health are detrimental. With oil heating all of this is done away with. The house is always heated at an even temperature due to the thermostatic regulation possible and in this manner health is again promoted. It has been said by those who have never investigated oil furnaces to any great extent that oil burners are noisy in operation. This was true of some of the original types but recent improvements have done away with this and other deficiencies and the public today can purchase well designed oil burners that will operate with the greatest efficiency and with the least amount of trouble and attention.

Atomic physics provides the key to the hidden secrets of the atom. In its excited state the atom does some remarkable "stunts." Some of these will be explained next month by a noted physicist.



A MINE ROOF COLLAPSES

The excavation of successive underlying strata of coal frequently causes heavy settlements at the surface. This shows such a settlement aided by a bursting water main

A SUBSTITUTE FOR THE MULE

The mule working, eating, stabled thousands of feet below ground in a mine was one of the curiosities of mining. Now a storage battery locomotive hauls the coal

Uncle Sam, Spendthrift—V

Waste in the Mining, Marketing and Using of Coal, and the Remedy

By J. Bernard Walker

HAVE you ever seriously considered how largely not merely the comforts but the bare necessities of your daily life are dependent upon coal? Do you live in a city? If so, note the following facts. Your daily life begins with the pressing of a button, in response to which coal, in the form of electric light, answers your call. The southern grape fruit with which you start your breakfast is on your table because ice and the locomotive, in order to get it to your table, have consumed an amount of coal equal to the weight of your grape fruit. Coal as power carries you to your factory or office; if to the factory, your labor is aided by coal through a power driven machine; if to the office, you are lifted to your floor by coal acting through an electrically operated elevator. By the way, this vertical transportation service consumes in New York City alone, 250,000 tons of coal per year.

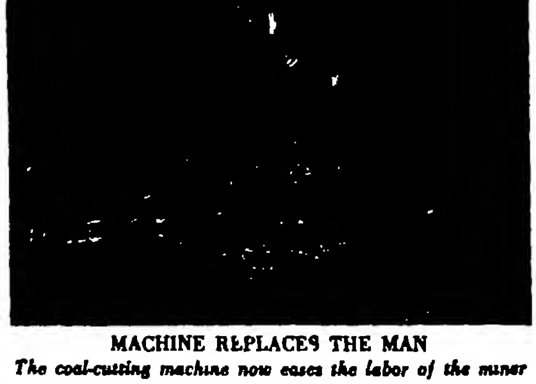
If you have the inclination and means to be up to date, your home is replete with many kinds of labor saving electrically driven appliances, for the operation of which you are indebted to that silent but ever present friend, King Coal.

Fertilizer From Coal

So great is the contribution of coal to the daily life on the farm as to justify the statement: The story of wheat is the story of coal. To provide modern farm machinery involves the use of coal in melting the iron out of the ore, in reducing the iron to steel, and in fashioning the steel into the harrow and the plough. We hear much in these days about nitrogen fertilizers, of which hundreds of thousands of tons are used every year on our farms. The nitrogen is a by-product of the coke oven, and one hundred and thirty tons of coal have to pass through the ovens to produce 100 tons of coke.

We are proud, and justly so, of the American harvester and threshing machine—coal has made them possible. The movement of the country's enormous crops to market could be accomplished in no other way than by our railroads, which are—and for many decades to come, at least in the wheat growing districts of the west, will be run by coal. Coal drives the flour mill, and for every pound of bread it is necessary for the baker to burn up one third of a pound of coal.

The United States Coal Commission says that between 40,000 and 50,000 tons of coal invisibly reaches our table every day, but even that amount is small compared with the annual production from our mines of 500,000,000 tons of bituminous coal. Of this total, 28 percent goes to the railroads, 25 percent to the boiler houses of factories and mills, 15 percent to the coke ovens and gas plants, 10 percent to the homes of the people, 7 percent to the steel plants, 7 percent to the power houses and street railways, 4 percent is exported, 2 percent provides power at the coal mines, and the last 2 percent represents steamship fuel.



MACHINE REPLACES THE MAN

The coal-cutting machine now eases the labor of the miner

Truly, the dependence upon coal is not merely countrywide but is all embracing. Hence the questions of the reserves of coal in the ground, their ultimate exhaustion, the rate at which they are being mined and consumed and whether they are being mined and used wastefully should be of the very deepest concern to every American citizen.

Skimming the Cream of the Coal Mines

The entire coal resources of the United States, exclusive of Alaska, have been estimated by the United States Geological Survey at the enormous total of 3,535,690,990,000 tons, which is nearly one half of the total resources of the whole world. This estimate was made in 1913. The annual consumption of bituminous coal was 417,111,142 tons in 1910 and 579,385,820 tons in 1918. The total production in this country from the first opening of mines to the end of 1918 was about 13 billion tons. Comparing this with the estimated coal reserve of over 3,535 billion tons, it would look as though the last thing the United States has to worry about is the exhaustion of its coal supplies.

But, when we look into the details of the coal situation, we find that it is not so favorable as the naked figures suggest. In the first place, of the enormous total given above, only 21 billion tons represents anthracite and less than half of the total, or 1,441 billion tons is straight bituminous coal. The balance is made up of semi-bituminous, sub-bituminous and lignite. Furthermore, during the years in which the country has been mining coal, it has naturally mined the best coals and those which lie nearest to the manufacturing and industrial centers. As Dr. George Otis Smith, Director of the United States Geological Survey very pertinently has stated, "To the coal consumer on the Atlantic Coast, the average life of America's great coal reserves means much less in dollars and cents than the approaching exhaustion of the fields that lie nearest his boiler house . . ." The tonnage remaining in the great

producing fields of the east is so limited as to make coal-saving a topic deserving the best thought of those concerned in power generation. Mr. Lesher, another authority, says, "The production of one billion tons of coal (as against the present production of say 500 million) in the United States in one year, is to be expected in the not very distant future."

As in the matter of our oil reserves, so in the case of coal—we have been skimming the cream by mining our best coals and leaving to posterity those which are of less value and will cost more to recover and transport. In 1881, the Pittsburgh bed in Pennsylvania was yielding 10 million tons a year and the life of that field was considered to be a matter of 30 generations. As a matter of fact, if that rich field continues to be mined at the present rate, the exhaustion of this, the largest coal bed in Pennsylvania, will take place within not 30 generations, but one. Again, the Georges Creek field—the main source of coal in Maryland—was yielding two million tons per year in 1880 and was estimated to have a life of 150 years. "To date," says Dr. Smith, "so far as the big vein is concerned, the field is regarded as almost worked out." The estimates of the life of the famed Pocahontas field have been reduced from four or five generations to two or three. The above are the fields which produce our choicest industrial coals, and although the outlook is better in the coal fields of Ohio, Indiana and Illinois, the coals are poorer and more remote.

A MODERN COAL BREAKER

Here the coal passes through the breaker where it is sorted to size, cleaned and delivered to coal trains

Huge Loss of Coal Avoidable

Since we are using up the best of our coal at a rapidly increasing rate, the question of economical practice in mining below ground and in the use of coal above ground takes on very great importance. Are we wasteful with our coal? Is there a call for thrift in the mine and the factory? Most assuredly there is a call for thrift in the mining of coal, for in a report made by the Bureau of Mines to the United States Coal Commission in July 1923, we find the following paragraph: "During the last 10 years, when the average production of all bituminous coal in the United States was 483 million tons per annum there was lost each year a total of approximately 250 million tons of coal. Of the total loss, approximately 140 million tons could have been avoided if better methods had been employed."

In 1912, the late Joseph A. Holmes, First Director of the Bureau of Mines, stated that, "in mining coal in the United States probably one third of the bituminous coal and about one half of the anthracite coal are left in the mine, and it is estimated that since coal mining began, two billion tons of anthracite and three billion tons of bituminous coal have been left in the ground, under conditions which make future recovery highly improbable."

Losses in mining may be considered as those which are unavoidable and those which are avoidable. Unavoidable losses are those in which it is impossible, profitably to separate the coal completely from the impurities either in the mine or in the coal cleaning establishments above ground. Other unavoidable losses occur where a coal bed is too thin to work profitably, or where, in a thick bed there are faults and disturbances or a dangerous or treacherous roof, or where overhead water courses would render it dangerous to the men employed.

Avoidable losses are those due to improper methods of mining bad engineering in carrying out those methods, careless cleaning of the coal, excessive blasting which blows the coal into dust, poor methods of transportation such as loading the pit cars too high, using cars with cracks or doors that let the fine coal sift out, and leaving unnecessarily large supporting pillars, the coal in which often is not recovered—this last representing one of the greatest losses in mining.

Having considered the causes of waste and the remedies therefor in the mining of coal, let us turn to the consumer and ask whether the future holds a promise of economy in the consumption of coal, comparable to that which as we saw in our last chapter can be realized by more scientific oil refining and more economical motors.

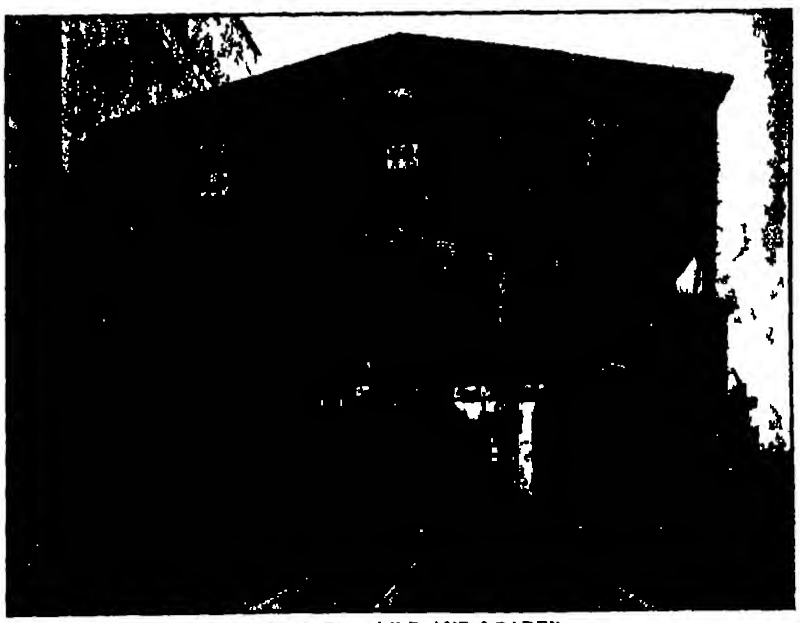
Railroads Increasing Efficiency

We are dealing in this story mainly with bituminous coal of which, as we have seen, the United States contains some 3,500 billion tons as against 21 billion tons of anthracite. Limitations of space prevent our considering the possible economies that can be secured in the various industries which are the principal users of bituminous coal. It will suffice to show what has actually been done in the reduction of coal consumption on one particular railroad, the Delaware and Hudson, to whose president, Mr. L. F. Loree, we are indebted for the following statement. He tells us that in 1915, the typical freight locomotive of his road was using saturated steam, sliding valves and single expansion cylinders. In moving 1,000 actual gross ton miles, including its own weight, on a 0.5 percent grade at average freight train speeds, this locomotive consumed 160 pounds of coal. The first marked improvement was the application of super heat and the substitution of piston valves for sliding valves. The fuel consumption of this engine in doing the same work was 130 pounds. In 1924, there was brought out the *Horatio Allen*, with a water tube type of firebox, super heated steam, and multiple expansion cylinders with large valve and port openings. This engine doing the same work under the same operating conditions, reduced the fuel consumption to 55 pounds of coal. Thus the same work is done with a reduction of coal consumption within ten years from 160 pounds to 55 pounds, and be it remembered that 25 percent of our bituminous coal is consumed on the railroads. By such scientific designing coupled with intelligent firing, similar economies in varying degrees can be secured throughout our industrial life.

In our November issue Chapter VI of this series on conservation will appear. It will deal with the deplorable extinction of some of our finest fisheries as the result of the spendthrift extravagance of the past

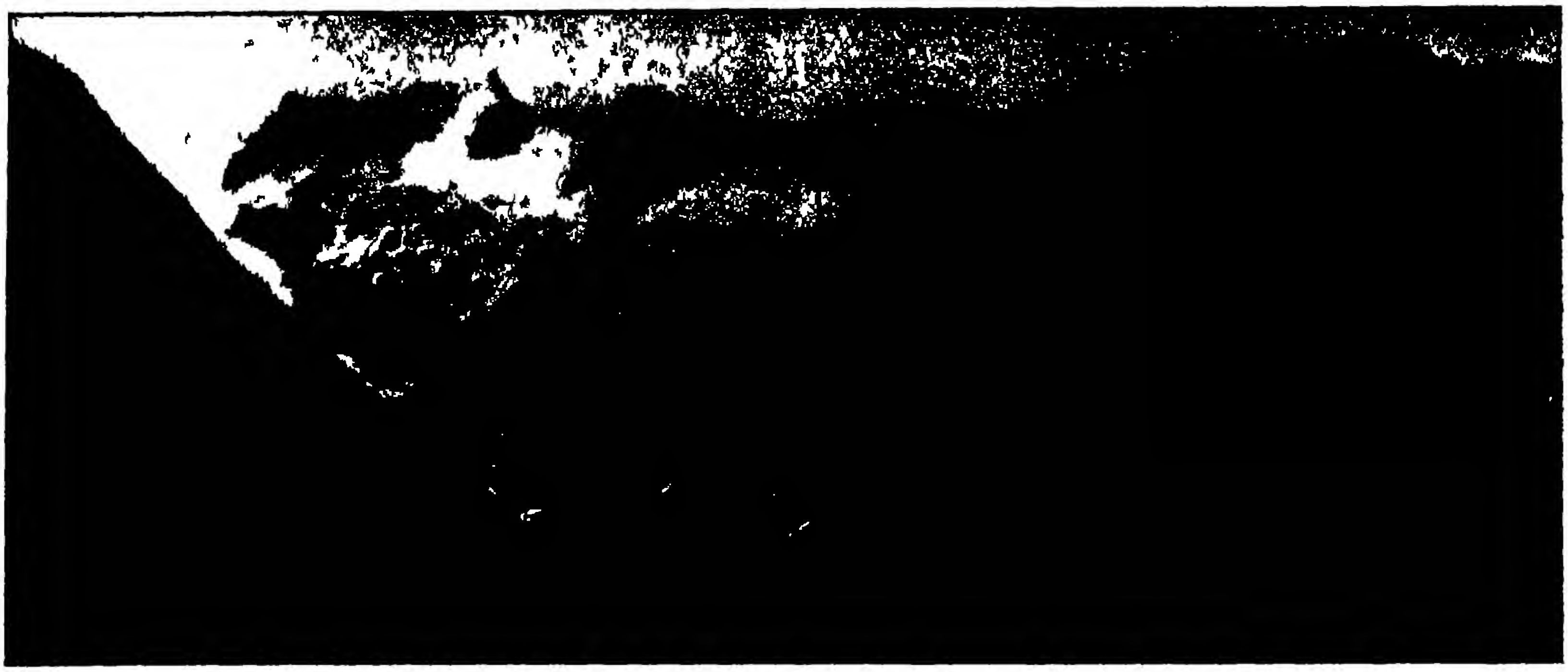
GRADING THE COAL

The coal passes on to these shaker screens in the tipple house, where it is graded to the required sizes. To the left are shown extra screens for special sizes of coal



AUTOMATIC SIZER AND LOADER

From the screens the coal is delivered to the coal cars. Here is an automatic sizer and loader, with three cars loaded from left to right with coal of increasing sizes



The Valley of the Skagit River in the State of Washington Is a Typical Glacial Valley U Shaped in Cross-Section

Little-known Ice Ages of Great Antiquity

Most People Know of One Glacial Period. But There Were Several Before That

By Albert G Ingalls

GEOLOGISTS used to believe that in the beginning the earth was molten and that it cooled down all through the geological ages, until comparatively recently, as geological time is reckoned, when it reached a point where the glacial period arrived. Today we know this belief to be wrong.

While most modern geologists still believe the juvenile earth was molten they know now that the glacial period which came about half a million years ago was only the last of a long series of glacial periods which began comparatively early in geological time—say, something like 500 000 000 years ago.

Usually it is the glacial period of the Pleistocene Epoch—less than a million years ago—that is meant when the geologist says "the" glacial period. This, however, is only because we know this glacial period best, and because for a long time it was thought to have been the only one in the earth's history.

Our Present Climate Is Abnormal

To establish a proper sense of time proportion, the following ice ages are known to have occurred. In the Pleistocene Epoch the ice age just mentioned began about 500,000 years ago and ended in our latitudes, about 25,000 years ago. In Greenland and Antarctica it has not yet ended. Other ice ages occurred in the Eocene Epoch about 20 000 000 years ago, at the end of the Triassic Period of the "Age of Reptiles," 65 000 000 years ago, early in the Permian Period, shortly after the greatest coal forming period about 90 000,000 years ago, at the end of the Devonian Period ("Age of Fishes") 120 000 000 years ago, in the Ordovician Period (marine invertebrates) 190 000 000 years ago, in the Cambrian Period 300 000 000 years ago and in the Archaean Era ("Age of Primal Life"), at least 500,000 000 years ago.

Life then has experienced many periods of cold, at least in parts of the world and triumphantly has survived them all. In fact many scientists believe the ice ages had much to do with hastening evolution, through increasing the struggle for existence.

Recently a notable book, semi scientific semi popular, concerning ice ages was published. "Ice Ages," in fact, is its title and its author is Professor A P Coleman of the University of Toronto. No such book has been available before. Professor Coleman has spent most of his life studying the evidences of past and present glaciation. He has traveled on every continent. He has probably gained a more rounded knowledge of ice ages than any living authority. "Ice Ages" (Macmillan and Company, 1926) is a summary of his life investigations.

Instead of beginning with the earliest known ice age Prof Coleman begins with the last and then works backwards in geological time. We are not now living in the earth's normal climate, Prof Coleman points out, but instead we are probably in the closing stages of the Pleistocene ice age. The fossil record found in the rocks proves that in the main the world's climate has been hotter than at present.

Courtesy of the American Museum of Natural History

"VARVES" IN PLEISTOCENE CLAYS NEW JERSEY

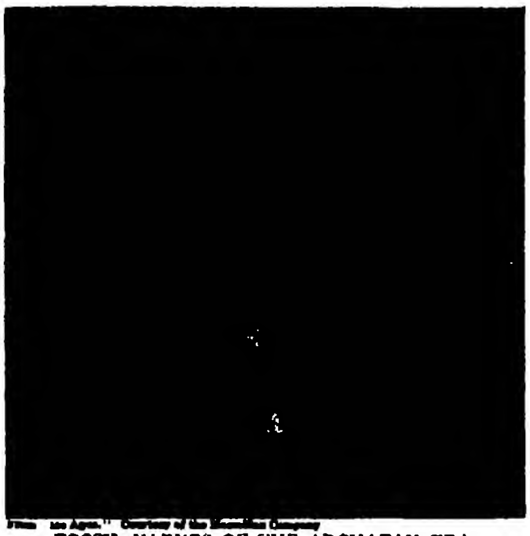
Varves are annual layers of silt and clay deposited in lakes bordering retreating ice sheets. They are like tree rings

Perhaps we take too fully for granted our salubrious climates. Do we stop to wonder how the earth came up through half a billion years without losing its animals and plants because of some cataclysm, some even lesser accident? Life is possible only between very narrow ranges of temperature. Had those ranges been transgressed rather swiftly, life could have been destroyed as one accidentally destroys the life of an ant on the sidewalk. That a little globe like the earth, exposed on all sides to the cold of space, should have maintained its temperature within the narrow limits of 32 degrees and 190 degrees Fahrenheit for half a billion years is a most astonishing fact when we come to weigh it.

Ice Ages Aided Evolution

Yet to man and other forms of life, ice ages have been most significant. For each of them constituted a severe test for living beings. Only the fittest survived them. Evolution, nearly stagnant in the long stretches between them, must have speeded up enormously at such "hard" times. Many believe that but for the last ice age there would be no human beings on earth. There would be apes. And, suggests Prof Coleman, "It may be that the races of civilized man are merely evanescent phenomena bound up with the bracing climates of a brief ice age, to sink, after a few more thousand years, into a state of tropical sloth and barbarism when the world shall have fallen back into its usual relaxing warmth and moisture." The Universe, the sun, even the earth does not care whether man continues to exist and advance or not.

In the last ice age, that of the Pleistocene Epoch, the ice spread over Canada and our northern states four times. The ice was doubtless more than a mile



From "Ice Ages," Courtesy of the Macmillan Company
FOSSIL VARVES OF THE ARCHAEAN ERA
These have become solid rock, turned on edge. Compare them with the unconsolidated varves on the opposite page

in vertical thickness. At each of these four advances the southern boundary of the ice stood at a different place because the four ice advances were not equal in strength.

Between each of the four advances or stages the great ice mantle melted back to the north, in some cases as far as it has at the present date—possibly farther. These were the "interglacial" stages, and some of them lasted in themselves from 30,000 to 150,000 years.

Now we go back *forty times* as far as the beginning of the ice age discussed above, to the Eocene Epoch when the ancestor of the horse was the size of a fox and had five toes, and man's ancestor was not yet even an ape. The ice age of the Eocene was, however, a minor one. Glacial drift of that age has been found in British Columbia, also at Ridgeway and Gunnison, Colorado, again in Australia and in Antarctica, in the latter of which an ice age—that of the Pleistocene Epoch—still lingers.

The ice age of the Eocene, 20,000,000 years ago, was probably limited to elevated regions and little importance would be attached to it were it not that it had so great an effect on organic evolution. It cooled the earth's warm climate and probably exterminated the giant dinosaurs that had long dominated the earth. Thus the tiny mammals inherited the earth, rapidly making the best of it, evolving into the mammals of modern days. "But for the slight dip in temperature," says Prof. Coleman, speaking of the ice age of the Eocene, "too small to be called an ice age, who knows but that some elect form of dinosaurs might now stand at the head of land animals and some pterodactyl rule the air!"

Most significant of all ice ages was that of the Permian Period about ninety million years ago. Strangely enough, its greatest extent was not at the present poles of the earth, but in India, Australia, Africa and Brazil. It was a great surprise when geologists found glacial deposits in these unexpected places, and saw that they contained the same boulders of granite that we find in our northern fields today, incorporated with what had once been glacial clay or till, into solid rock—and between such deposits of "tillite" found layers of coal formed during interglacial stages of ninety million years ago.

Prof. Coleman visited India where he was able to measure the direction of movement of an ancient glacial cap of the Permian Period by the plainly visible striations on the surface rocks of that day. "The crumbling face of the tillite," he says, "might well have been boulder clay by the shore of a Canadian river." In Africa he found much the same evidence but it was even more widespread than in India. So thoroughly consolidated was this ancient till that he says, "Attempts to break out pebbles from the matrix were usually failures, since the fractures passed through matrix and stone impartially."

Southern Africa Under Ice!

There is ample evidence that the Permian ice age lasted through 2,000,000 years, for the African tillite accumulations are twice as thick as the tills of the last ice age. The glaciated area in Africa probably extended northward even to the present equator, thus covering all of the southern half of Africa.

In Australia the essential features are similar to those in Africa, even to the existence of interglacial beds. Here, too, the ice moved toward the equator. In Brazil, Argentina and Bolivia during some of the Permian Period, there was an ice cap 2,380 by 1,400 miles in extent. Other evidences of this ancient glaciation may be found in Nova Scotia, and at Squantum, near Boston.

"It is not surprising," continues Prof. Coleman, "that the life of the world suffered great losses during these changes of climate, clearing the way for great advances when the glacial hardships were over. But for this rude interruption possibly gigantic insects with large brains might have led the world intellectually in later times instead of vertebrates. Knowing how efficient and ruthless are the instincts of our tiny modern insects, the thought is somewhat appalling."

The ice age of the Devonian Period is not very important, and we must also skip those of Silurian, Ordovician and early Cambrian times. In the Archaean Era not long after the earth's crust was molten we find evidences of another glacial period similar in intensity to those of the Pleistocene and Permian. The most striking of these exists in Canada, where the ice of the Pleistocene, which came 500,000,000 years later, actually laid bare some of the tillites of its earliest known predecessor! Near Cobalt, famed Canadian silver mining camp, tillites with striated surfaces and angular rock fragments are to be found. Prof. Coleman states that "the glacial origin of the Cobalt tillite is as well established as that of any other ice age."

From "Ice Ages," Courtesy of the Macmillan Company
CAMBRIAN PERIOD TILLITE, UTAH
Glacial drift boulders of gneiss and quartzite in former clays three hundred million years old, now wholly consolidated

But we cannot go further. Enough evidence has been adduced to show that the earth was not, as was formerly supposed, in an uninterrupted state of warmth during its early and middle life, any more than it has been in comparatively recent times. Also that there have been many relatively short periods of cold, and that these have had an especially significant effect on the evolution of animal life, culminating in man himself.

What caused the ice ages? Of this, man is still ignorant. In his last chapter Prof. Coleman reviews the several theories that are worthy of consideration. But he says, "No theory is generally accepted. The opinions of those who have written on the subject are hopelessly in contradiction with one another and good authorities are arrayed on opposite sides."

Someone once surveyed the whole of glaciological literature and counted 77 theories that have been proposed to account for ice ages—or was it 777?

Who, then, dares add another?

From "Ice Ages," Courtesy of the Macmillan Company
ICE-WORK PERFORMED NINETY MILLION YEARS AGO
A glacier of the Permian Period striated and polished this rock in Australia exactly as the Pleistocene glaciers polished rocks only one hundred thousand years ago

From "Ice Ages," Courtesy of the Macmillan Company
STRIATED ROCKS AT KIMBERLEY, SOUTH AFRICA
The glacier that smoothed and scratched this rock might easily have done its work in Greenland yesterday, for the evidence, despite its great antiquity, is just as obvious

EXCAVATING DIRT AND REMOVING RUBBISH

The steam shovel is busily engaged in removing the earth. The derricks, some of them supported at street level on timber towers, are handling the rubbish

WORKING ON THE SHATTERED ROCK

The blasted stone is being removed by the steam shovels. Many scale pans are shown, awaiting filling and subsequent hoisting by one of the derricks at street level

Huge Job of Solid Rock Excavation

How Engineers Drilled and Blasted Through 50 Feet of Manhattan Rock to Reach a Firm Foundation for a 45-story Building

By Frank W. Skinner, Consulting Engineer

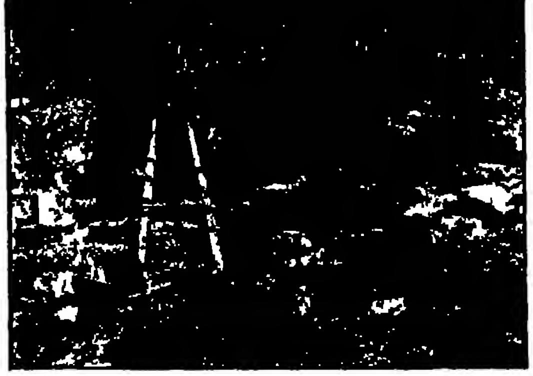
WITHIN a few months the new tenants of offices in the 45th story of the New York Life Insurance Building will have from their windows, a wonderful view of a metropolitan panorama unrivaled in the world. This they will see from a point 100 feet or more directly above the place where once stood 340 feet above the pavement the exquisite figure of Diana that dominated the Madison Square Garden Building.

This historical structure so inseparable from many pages of New York's history has been ruthlessly demolished and great quantities of the ground beneath its foundation have been removed to make way over the whole area of a full size city block, for the substructure extending four stories below street level of the new skyscraper. This involved the excavation of nearly 150,000 cubic yards of earth and stone from a pit 72 feet deep. The method and appliances for its safe and rapid excavation in the heart of the great city without injury or danger to life or property was a worthy engineering feat. It is all the more notable because it was accomplished so easily and simply directed by skill and experience that coordinated an army of men and the most powerful and improved machinery in efficient operation.

Pit Kept Clear of Derricks

Although few buildings in New York have four stories below the street level, yet many of them have foundations carried much deeper than this and the latter almost invariably stop as they reach satisfactory rock bottoms. They are generally sunk by the pneumatic caisson process through the treacherous quick sands and subterranean rivers. In the new building such difficulties were encountered that it was necessary to penetrate nearly 50 feet through a solid bed of hard rock, hundreds of thousands of tons of which were blasted by high explosives and handled by powerful machinery that reduced hand labor to a minimum.

Because the slow demolition of the old Madison Square Garden had greatly delayed the building schedule, the contractor concentrated his energies and resources on securing the greatest rapidity and efficiency of operations. Instead of setting up derricks here and there, or perhaps building a system of railroads to convey the excavated material from all points to a central loading station, thus continually shifting his plant as the pit deepened, he kept the whole 200 by 425 foot area at all times clear of obstruction and commanded most of it by a great battery of eight huge derricks installed around the edges of the excavation at street level. From here they reached over almost all of the working area as well as the adjacent streets, and were permanently



IN THE DEEPEST EXCAVATION

Notice particularly the derrick on its cantilever support and the heavy shores bracing the treacherous rock stratum

located so as to require no movement throughout the continuation of the job. Also, around the edges of the pit there were installed shops, tool houses, store houses, offices and a power plant, all enclosed by a high board fence protecting them and excluding the public.

At first the great derricks were seated on the old cellar floor and as the earth was excavated below them, they were mounted on timber crib work built up as the pit deepened until the rock was exposed. Then the cribs were replaced by sturdy timber towers. The rock supporting these towers was allowed to remain like pilasters in the face of the sides of the pit until after all the rest of the excavation was almost completed.

At the east end of the lot, where old sidewalk vaults extended beyond the building line, heavy blocks of concrete were built in them on the surface of the rock. These supported sets of projecting horizontal steel I beams embedded in the upper part of the concrete and anchored to the whole mass so that it served as a 50 ton counterweight to balance the overhanging derrick placed on a little wooden tower on the extremity of the beams.

Settling of Street Guarded Against

In the bottom of the 72 foot excavation, a timber tower was built to carry a platform at the level of the bottom of the 44-foot excavation, and trucks descending the slope from the street were loaded there with rock from the deep pit, hoisted by the cantilevered derricks. While the earth was being excavated by steam shovels, similar tower supported platforms were built on other sides of the pit, permitting trucks on them to be loaded by the derricks without obstructing the street while they waited.

Within the boarded enclosure, all of the work was carried on by an army of sometimes as many as 325 men, three powerful steam shovels, a great number of pneumatic drills, a large fleet of five ton motor trucks, as many huge rectangular steel "scale pans" in which the rock was loaded and hoisted by the derricks, and by the necessary equipment of power-

ful electric and gasoline pumps. These raised, to a height of 60 feet or more, the hundreds of millions of gallons of water that flowed in through the seams in the rock and were collected in two temporary wells driven down in advance of the general excavation.

Long before the base of the beautiful old campanile tower was removed by the wrecking contractor, the steam shovels were hard at work tearing out huge fragments of old foundations, concrete floors and debris, working back and forth across the lot, and gradually descending about 20 feet to the irregular, approximately horizontal surface of the bed rock. They seemed like great antedeluvian monsters bearing a whimsical resemblance to huge mud turtles with their outstretched necks and little heads. Their snapping jaws were steel toothed buckets, which ferociously devoured earth and rubbish at the rate of a cubic yard per mouthful, and immediately disgorged it into the trucks. A constant procession of these trucks waited alongside until loaded, and then passed on to the steep incline and hastened away to deliver their loads to scows awaiting them a mile or two away in East River slips. From here these were towed to sea where they dumped their burdens in deep water.

To safeguard the vertical earth banks enclosing the upper part of the pit, the excavation around the edges was often finished or trimmed by hand. Where the earth appeared treacherous, it was immediately covered with planks. These were well braced until a massive concrete wall, seated firmly on the solid rock surface, could be built up to line the pit, and form a part of the permanent structure. This expedient eliminated a large amount of costly sheet pile driving, and effectually prevented any settling of the street.

After the surface of the hard gneiss rock was uncovered, more than 40 portable pneumatic drills were set to work drilling thousands of holes two inches in diameter, and about 12 feet deep. Then dynamite shattered the rock sufficiently to enable most of the pieces to be handled by the steam shovels, although some of them had to be drilled and blasted again. The blasting was done in strict accordance with all of the numerous municipal regulations and requirements provided to safeguard the public. The holes were blasted in groups at morning, noon and night, care being always taken to cover each group with from eight to 20 large square mats woven from heavy steel ropes, and weighing about one or two tons each. These blanketed the explosions so effectually that no fragments of flying rock injured any persons or property.

Powerful electrically driven machines with a capacity for compressing 2,500 cubic feet of air per minute were operated to maintain pressure in a huge pipe that circled the pit at street level. Vertical branches extended from the pipe down the walls of the pit, and were valved at the bottom to 50 foot lengths of flexible hose supplying the pneumatic drills.

Six Tons of Drill Bits Dressed Daily

As much of the shattered rock as possible was loaded into three sided scale pans or boxes that were chained to the derricks and swiftly lifted out of the pit. Here their 10,000-pound contents were dumped into trucks waiting at street level. Even though their booms were 70 and 80 feet long, these great derricks failed to reach quite to the center of the lot, and a portion of the rock excavated there had to be loaded by the steam shovels into trucks in the pit, which had to climb higher and higher to street level as the bottom of the pit descended day by day.

Great care was taken to avoid swinging the derrick booms over the steam shovels, and their constant operation at so many points supplemented the shovel work, and enabled the rock to be removed as fast as it could be blasted and loaded.

The steam shovels were operated by a crew of seven men, the engineer, fireman, and five "muckers" who handled the rock and loaded the scale pans with fragments not picked up by the steam shovel buckets. One steam shovel loaded as many as 61 five ton trucks in a single eight hour day, and in 91 working days, all the shovels handled 5,870 truck loads of rock, nearly 28,000 cubic yards of which were sold to builders who used it chiefly for foundations, cellar walls, and the like, mostly in nearby localities on Long Island, the remainder being dumped, like the earth, at sea 25 miles away.

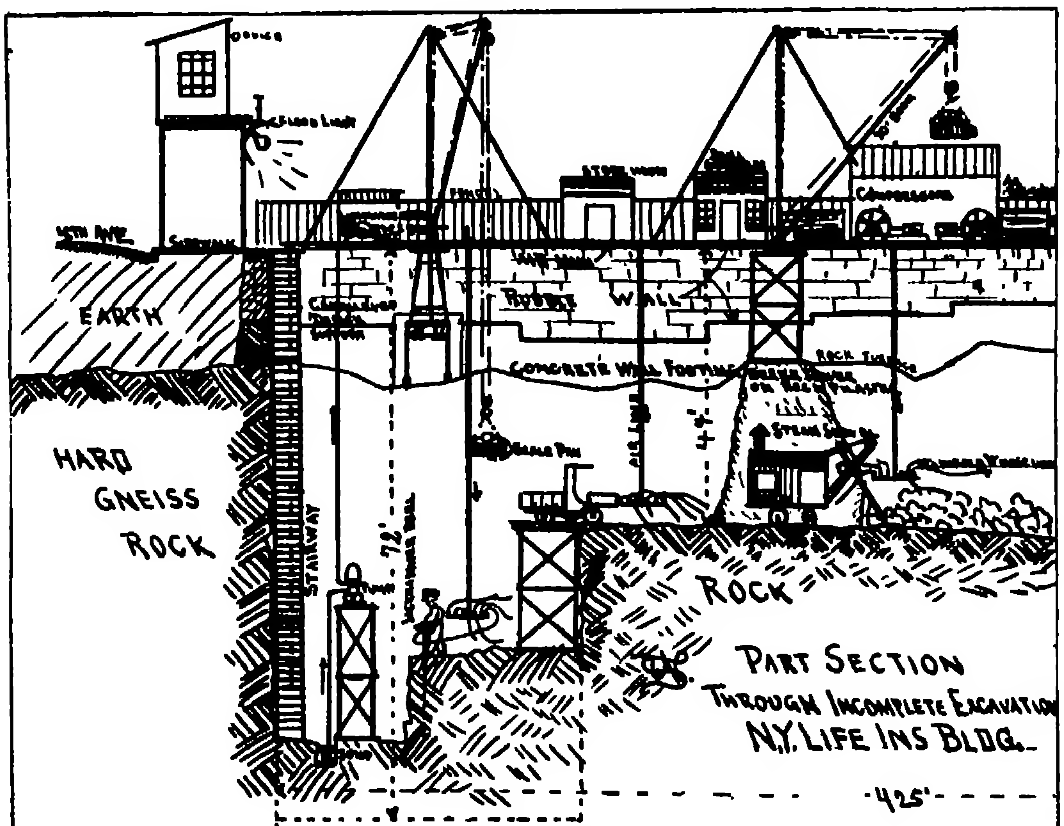
The great steel scale pans with their five-ton loads of rock were hoisted from the floor pit to the trucks at street level at a speed of 350 feet per minute. Six or eight of the scale pans for each derrick were available for filling simultaneously in different difficult positions so that the rock did not have to be carried to them, and one was always ready as quickly as another one was hoisted and dumped.

Each of the derricks was equipped with a powerful double-drum hoisting engine, and an additional smaller engine for swinging the long heavy boom while the load ascended, thus requiring a minimum of operating time.

The hard rock dulled the six point drill bits so rapidly that it required six men and two sharpening machines to dress about six tons of them daily. The steam shovels, consuming a ton and a quarter of coke a day, were so sturdy that this hardest of services only entailed a cost of a little less than one cent per yard of rock handled, for repairs, which altogether, cost less than 123 dollars in three months. At night, although only the pumps were at work, the entire excavation was brilliantly illuminated by eight 1,000-watt flood lights.

The bottom of the finished pit is at two elevations, one of them 44 feet, and the other 72 feet below street level. It will be lined with waterproof concrete, and will afford ideal foundation for the hundreds of thousands of ton loads from the steel columns in the lofty skeleton of one of the tallest buildings in the world.

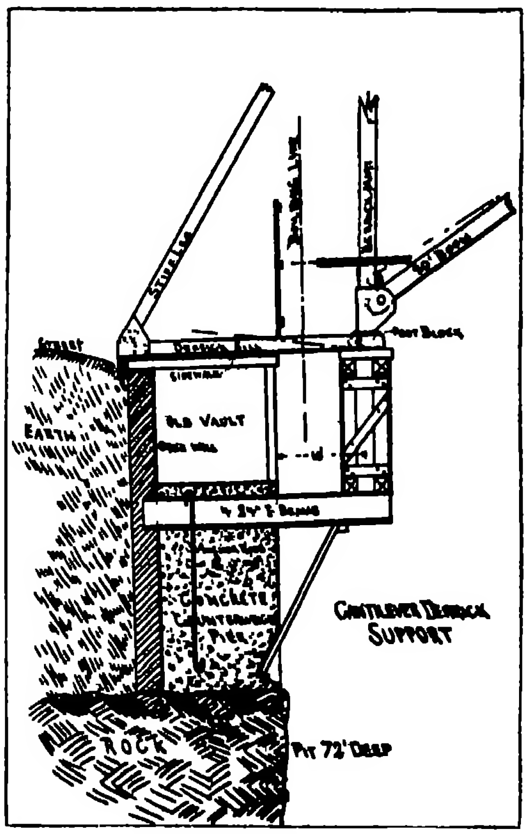
Mr. Skinner has prepared another article for us, and it deals with the construction of what is said to be the largest storm sewer in the world. This article will appear in a forthcoming issue and will, of course, be fully illustrated.



From pencil sketches by the author

HOW THE WORK IN THE EXCAVATION PROGRESSED

The various problems that the engineers had to solve are graphically shown in the above illustration. The strata of dirt and rock which had to be removed are all indicated. The motor trucks were driven down a ramp to the pit



AN ENGINEERING FEAT

Cantilever derricks at the eastern end were supported by the novel counterweight and bracing system here shown

The Scourge of the Japanese Beetle

Bug Fights Bug in an Attempt to Rid Certain Eastern States of an Insect Blight that Threatens to Destroy Many Plant Growths

By J. I. Miller

WHENEVER a new insect pest invades our fields the entomologists sent forth to exterminate or control it wage war not only with poisons and powders and sprays but with armies of beneficial bugs. They go into the country from whence the pest has been imported, often to the far corners of the earth—to study the enemies that kill and harrow the pest in its native land. These they colonize alongside of the devastating insect and so curtail its enormous rate of increase.

Such are the methods being used against our latest pest, the Japanese beetle—an insect which has been termed by some entomologists as the most devastating that has ever threatened the fields of any country. It is a beautiful green and gold creature about the size of a potato bug and it ravages almost every green thing. Indeed over 212 varieties of trees and plants have been cataloged as providing food for this indiscriminating insect. It was accidentally introduced into New Jersey in grub form in nursery importations prior to 1916. It has since spread over 2400 miles of land—over a territory having Riverton in New Jersey as a center and embracing a section of Pennsylvania about Philadelphia and a corner of Delaware.

THE JAPANESE BEETLE
An enlarged view of the destructive Popillia japonica

Kept in Control in Japan

The significance of the beetle was recognized from the beginning. The fight against it was taken up by the national government and by the states of New Jersey and Pennsylvania. At first it was imagined that it might be possible to stamp out the beetle entirely by intensive spraying and by cyaniding the ground. Boys also were hired to collect the pests at so much a quart. The fight was a losing one for the beetles spread outwards at the rate of from 10 to 15 miles per year regardless of any measures that could be taken against them.

The idea of confining the beetles in as small a territory as possible until some method of adequate control could be devised was then adopted. That is the reason why every road leading out of the beetle territory is patrolled by government inspectors from June to October—the months of activity for the pest. Every automobile is stopped and contraband produce or plants are confiscated. Produce may be shipped out of the beetle territory upon inspection but soil and manure and other materials must be treated in such a manner as to destroy all insects, grubs or eggs that may be present. The quarantine has been very successful in preventing the long distance spread of the insect. It is however impossible to check the natural advance of the pest and it will only be a matter of time before it will be found all over the United States.

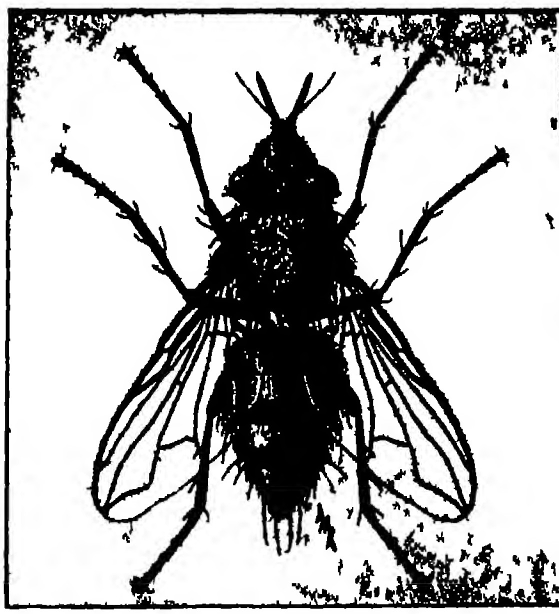
When it was seen that the beetle could not be exterminated, the Government sent two of its experts, C. P. Clausen and J. L. King, to Korea and Japan to study the insect in its native habitat. They discovered that the beetle was not considered a pest in Japan and that it was kept in control by various parasites which either destroyed the beetle itself or its grub. There is a perfect balance in nature which prevents any insect from becoming unduly numerous. When the Japanese beetle was introduced into the United States, the hereditary enemies were left behind and for once in all the ages of its existence, every egg developed into a full grown adult instead of perhaps half a dozen out of every hundred.

The problem was to discover the deadliest enemies of the beetle and then introduce them into the United States. Various destroyers of the pest were cataloged and the work of collecting larvae and adults begun. During the past four years, consignments of these beneficial insects have been arriving at the Riverton laboratory every few weeks or months. The parasites or their grubs are collected by Korean women and boys, packed in moss filled match boxes and shipped as is fruit in a cooled car or ship. Some of the imported insects were unable to stand the climate of New Jersey and died. Others thrived and have been released upon the beetle infested territory.

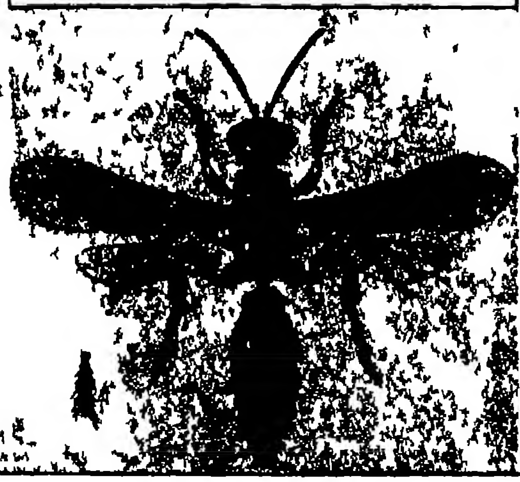
Its Foes Imported Also

It was soon discovered that in Japan the chief foe of the Japanese beetle was an insect known as the *Centeter cinerea*, a fly belonging to the tachinid group. This creature, somewhat smaller than the ordinary housefly, has minute greyish stripes running horizontally along its body and is responsible for the death of 50 percent of the Japanese beetles in their original habitat. This fly lays several eggs scarcely larger than the point of a pin directly behind the head of the beetle. In a short while they hatch and the tiny grubs bore into the body of the host filling themselves with beetle meat. The beetle becomes sick and buries itself in the ground, dying in six days from the time the *Centeter cinerea* laid eggs upon its body. The baby *Centeter cinerea*, however, does not die but pupates within the dead body of the Japanese beetle. When spring comes again it emerges as a fly and goes forth to lay more eggs upon Japanese beetles and thus continues the cycle.

We learn from a paper written by Mr. Clausen and Mr. King that, as many as fourteen eggs were



CENTETER CINEREA
This is one of the most important of the parasites that limit the rate of increase of the Japanese beetle



TIPHIA POPILLIAVARA
This is the Japanese parasitic wasp that is being used in the Japanese beetle war

PROSENA SIBERITA
This parasite the dexid fly is responsible for killing 10 to 12 percent of the Japanese beetle in Japan

THE HIGHLY DESTRUCTIVE WORK OF THE JAPANESE BEETLE

LEFT *An attack has been centered on an apple* CENTER *The beetles are engaged in devouring grape leaves* RIGHT *An ear of corn partially destroyed*

found on a single beetle in the field, and of all eggs laid, from 70 to 99 percent were upon female beetles During the alternate years 1921 and 1923, the parasitism was slightly less than 50 percent, with between 98 and 100 percent of the eggs on female beetles At Koiwai where the beetle is fairly abundant each year, the parasitism ranges from 75 to over 90 percent, as based on four years' observations During the past three seasons, a total of 296 000 parasitized beetles have been collected, as many as 56,000 having been secured in a single day, and the puparia from these shipped to New Jersey" Mr King says that the abundance of beetles and general conditions are similar to those in New Jersey but that it is very doubtful if the percentage of parasitism will be obtained in this country

Various Enemies of the Pest

The *Centeter cinerea* has shown itself very well adapted to the climate of the United States The first brood was set free upon the beetle infested area in 1921, followed by a second in 1922 and by a third in 1923 Later, a separate colony was set up in Torresdale, Pennsylvania A recent check up on this parasite shows that it has already spread over 16 square miles of territory—an even greater rate of progress than the beetle itself

A second link in the chain of parasites which is being built up against the Japanese beetle is the *Prosena siberita* or dixid fly—a parasite responsible for the death of from 10 to 12 percent of the pests in Japan Like the *Centeter cinerea* it, too resembles a house fly but is somewhat larger It however, does not attack the adult beetle but attacks the grubs hidden in the earth When springtime comes, it drops from 600 to 700 living larvae or maggots upon the ground These, guided by the sense of smell, seek out the grubs of the Japanese beetle They attach themselves to the trachea or breathing tube of the developing insect and immediately start growth, deriving their air therefrom They pass the winter within the bodies of their victims and in spring begin to increase in size This takes place so rapidly and so great a quantity of the body fluids of the host are consumed, that the young Japanese beetle dies The *Prosena siberita* then pupates for about 18 days, after which it emerges as an adult fly

This parasite has likewise been found to thrive in the United States Last year the first colony was set free on a golf green near Moorestown, New Jersey and this year another batch of 4,000 individuals has been released Golf courses have invariably been selected as colonization places for the *Prosena siberita* mainly because such places, being undisturbed by the plough, always have the greatest infestation of grubs—sometimes as many as a thousand or more to the square yard

A third parasite of which big things are expected by the scientists is a small Japanese wasp—*Tiphia popilliavora*—with a small and dark but business like kind of body It, too, attacks the grub rather than the adult itself The wasp, guided by its keen sense of smell, burrows down into the ground like a little drill until it reaches the grub of the Japanese beetle Rendering it temporarily impotent by stinging, it lays an egg upon its body Within seven days the wasp grub hatches It clings to the baby beetle with its mouth and sucks so great a quantity of its vital juices that the beetle dies after a few weeks The little wasp then spins a silken cocoon and awaits the coming of spring

A fourth enemy of the Japanese beetle which was brought to the United States but which failed entirely because it was unable to adapt itself to conditions was a predacious carabid beetle—*Craspedonatus tibialis* This insect which is found in great quantities at a spot a few miles from Tokyo, attacks and kills the Japanese beetle wherever found Seventeen thousand of these beetles were shipped to Riverton, New Jersey, but none lived Perhaps it was the climate or maybe the heavier soil At any rate, they died

Other possible destroyers of the Japanese beetle are being experimented with and studied both at the Riverton laboratory and by Mr Clausen Loren B Smith entomologist in charge of the Japanese beetle

KILLING A BEETLE GRUB

The grub of a Japanese wasp attaches itself to the beetle grub in the manner shown

project, desires a whole chain of parasites so that if one or more fails others can take their places

In summarizing the work in Japan and Korea during the past four years it may be stated that eleven species of parasites have thus far been found which normally do or can develop on *Popillia japonica* (Japanese beetle) three of these being upon adult beetles and the remaining eight upon or in grubs With the exception of one Tiphia all of these have been or will be introduced in numbers sufficient to establish them if such is possible In general the work is very encouraging, and if an effectiveness equal to that in the native home of *Popillia japonica* is secured it should go far toward reducing the ravages of the beetle

No Danger from Its Various Parasites

But may not the various parasites develop into worse pests than the Japanese beetle itself? Nothing is a more remote possibility Those in charge of the introduction of the parasites would be poor scientists indeed were they to guess at so important a question Experiments are conducted in the laboratory to determine just how the insects will react to their new conditions Take the example of the *Centeter cinerea* Its eggs can only be laid upon the back of the Japanese beetle and without the Japanese beetle it must perish When it is a fly, it lives upon the sweet juices of flowers and is perfectly harmless The *Prosena siberita* is similarly dependent The Japanese wasp likewise requires the grub of the beetle to rear its young and even were it to adapt itself to other kinds of grubs—which does not seem probable no harm would result Incidentally the introduction of parasites has its difficulties The *Centeter cinerea* itself a parasite, had to be divested of the parasite which would have destroyed it in turn

A second opposition which one sometimes hears voiced against the introduction of the parasites has to do with a belief that nature will find a way out and that she will of her own accord restore a balance between the pest and its destroyers Thus the fight is vain and useless Yes nature probably would equalize things in time but she is too slow about it and before her work were accomplished millions if not billions of dollars worth of crops might be destroyed She has already done this very thing in several instances During the 70's and 80's of the last century the cabbage butterfly and the potato bug were considered pests of the first magnitude Today, they still exist but no one ever stops growing cabbage or potatoes on account of them

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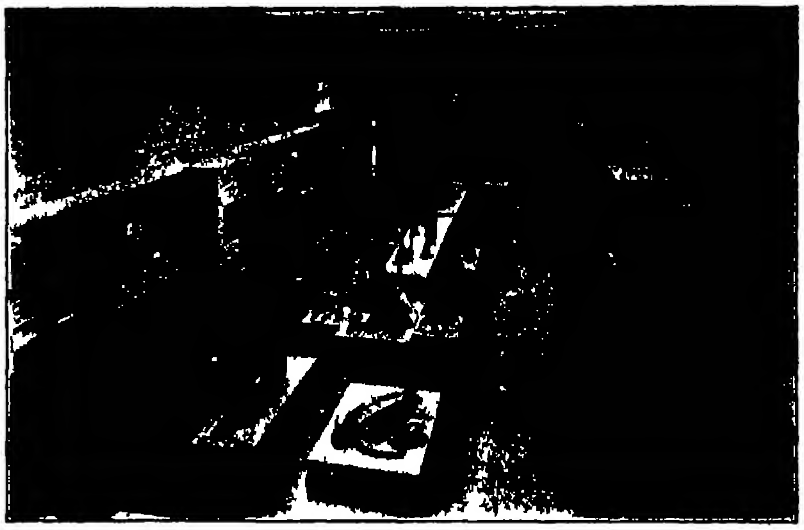
Do you know what the term arthropod means? It is a word that should be a common part of the vocabulary of all nature students It will be explained in full in our November issue

NEW MUSEUM AT NEW HAVEN, CONNECTICUT
The institution is sixty years old but the building is brand new



THE GREAT HALL OF THE PEABODY MUSEUM
Most museums fatigue the visitor with detail. Yale avoided this

Yale's Great New Museum of Evolution

The World Has Many Museums, But the Peabody Museum at Yale Is Unique—There Is No Other Like It

By Richard Swann Lull, Ph.D., Sc.D.
Professor of Paleontology, Director of the Peabody Museum, Yale University

A MONUMENT to those early pioneers of science—Othniel C. Marsh, Addison E. Verrill, James D. Dana—first curators of the Yale collections which rank among the finest in the world—was dedicated at the end of last year in the form of a magnificent building, the new Peabody Museum.

Built for the service of the university, the public and the world of science in its larger sense, the importance of this event will be appreciated when it is realized that this institution—the history of which falls into three distinct periods—has seen a half century of formative life. It was founded in 1866.

Then came a period of apparent quiescence from 1917 to 1925 due to the inadequacy of the old building and the necessity for clearing its site for the Harkness Memorial quadrangle. The institution at any rate from the public viewpoint had apparently ceased to exist for the collections were largely inaccessibly stored awaiting their adequate rehousing.

The period of apparent dormancy was prolonged, partly by the Great War which made other activity relatively of so much greater immediate moment and partly by the hope that mounting construction prices would go over the top and return more nearly to a prewar level. After seven such lean years signs of approaching activity could be seen—preparation and completion of plans and their fruition in the new building, moving, arrangement and installation of the collections.

The arrangement of the collections in the Peabody Museum is such as to fulfill a three-fold purpose: first, collegiate instruction to serve as tangible illustrations of class room discussions covering fields of interest not only to scientific students but to those of the humanities as well, for in the various exhibits educational values are everywhere emphasized. Second, for the instruction of the general public. New Haven, a city of some 170,000 inhabitants, has no other museum of natural history. This means not alone the impressing of the ordinary adult citizen or alien but also third, instruction to school children, either direct or indirect in cooperation with their regular instructors. In other words, there is a children's department ably administered which after but three months of practical life is already a strongly felt factor in the instruction of youth.

The function of productive research has naturally somewhat abated during the past year, when all the energies of the staff were turned to intensive installation, but it will be revived, it is hoped, on a larger scale than ever. There is yet much investigation to be done with the collections. However, it can hardly be so spectacular as in the old days, for the pioneers Marsh and Verrill were publishing paper after paper, each the notice of an amazing discovery in a virgin field which has since been exploited so fully that new discoveries are not easily made. These were in every way comparable to the results of the American Museum's present day expeditions in far Mongolia.

From Unicell to Man

The Gothic design of the Peabody Museum, with its lovely canopied porch, gives it an atmosphere that is rare among buildings devoted to such a purpose. The somewhat irregular relationship of the various portions serves to accentuate the beauty of the fabric. This made it possible to plan an exhibition sequence which compels the visitor to be orderly in his study of the whole, rather than to permit random wandering with a confused notion of what it all means. This is especially true of the first or main exhibition floor, less so of the third.

In the first hall to be entered invertebrate fossils are displayed, arranged stratigraphically in their orderly historic sequence, with explanatory labels and diagrams and maps showing the changing coast line of North America in each successive era.

The entire remainder of the lower floor has been given over to an exposition of the continuity of animal life from the lowest unicellular forms, whose minute size necessitates the use of enlarged models rather than actual specimens for their exposition to man. In this museum, however, for the first time at any rate in America, material is drawn from the entire collection of animals both existing and extinct, for it is manifestly impossible to tell a complete story of continuity if one excludes either the one or the other series. Some groups are known to be ancient of which there is no fossil record, others are entirely extinct but betray relationships between existing orders which would otherwise not be demonstrable. This exhibit also makes possible ready comparison of ancient types with those now alive and thus clarifies the student's understanding of the former.

Due in part to accidents of preserval, in part to past dominance, the Protozoa and insects will be largely recent and the reptiles largely fossil, but exhibits are fairly balanced, in so far as the collections permit. The remainder of the wing contains the invertebrate phyla, whereas the Great Hall displays the first of the vertebrates, fishes, amphibians, reptiles, and birds, the third and fourth halls the mammals, and the fifth the higher primates including man.

Among other notable special exhibits in the Invertebrate Hall will be a display of Permian Period insects collected in Kansas by Curator Dunbar in 1921 and now in process of detailed scientific study by Dr. Tillyard of Cawthron Institute, New Zealand. This collection, which is by far the largest ever assembled from this remote geological period, contains many admirably preserved forms which were unknown to science, thus clarifying our conception of insect relationships.

Another special collection has been prepared by Curator Emeritus Charles Schuchert, long identified with the museum as Curator and Secretary of the Board of Trustees. These are lamp shells or Brachiopods, which, together with certain beautiful preparations by his predecessor Professor Charles Beecher, demonstrate within the one group all aspects of the evolutionary hypothesis.

The Great Hall is in reality a closed court, flanked on three sides by the remainder of the building and extending up through the height of two stories, with a gallery at the southern end given over to fossil footprints and other phenomena of the Connecticut Valley Triassic Period rocks. Here the great dinosaurs, all original type specimens, in which the Museum is especially rich, will ultimately be mounted, in fact, a few already are displayed.

The flying pterodactyl from the Solenhofen lime-

stone of Bavaria, *Rhamphorhynchus phyllurus*, the first in which the wing membranes were preserved, shows the minute wrinklings of the delicate structure with marvelous clarity, and that to the unaided vision with no especial treatment other than that given to every other specimen in the room. Here, as elsewhere, the most careful selection of material has been made, not for its rarity, but to demonstrate a truth or essential fact bearing on the majestic hypothesis which accounts for the existence of organisms as part of an orderly developmental creation. As a consequence, but a fifth part of the great collection of fossil vertebrates is shown, the remainder being in systematic storage in the basement where it will be readily accessible for further detailed research.

Indeed it may be said that that which is shown is already known to science, and much of it has formed the source of our knowledge and has served as illustrative material, descriptive and pictorial, in books and treatises the world over. Here are all save one of the Connecticut Valley Triassic dinosaurs, here some of the most remarkably preserved primitive reptiles from rocks of the Permian Period of the southwest, here the most venerable footprint of a terrestrial vertebrate thus far discovered, and here the toothed birds which inspired Marsh's memorable memoir and called from Charles Darwin a most remarkable testimony of their value as evolutionary evidences.

Specimens Praised by Huxley

The Mammalian Halls are also rich in classic material, such as the tiny jaws and teeth of early mammals which existed, but did not evolve materially, during the age long period of reptilian dominance. Of these the museum contains perhaps two-thirds of the known specimens of the world, announced years ago by Professor Marsh, but now the source of a most illuminative research on the entire Mesozoic Era group.

The classic horse collection is equalled if not exceeded in the degree of completeness of individual specimens in one or two other places, but it has the unique distinction which can never be taken from it of being the first demonstration of the phylogeny or evolutionary history of a race! These specimens Huxley studied during a memorable visit to America and eulogized, as did Darwin the ancient birds. Throughout these halls the latest museum practice is in evidence such as the absence of shelving, fewness of specimens, selected, as has been said, for their instructional values, carefully thought-out labels, and, above all, attractiveness and atmosphere to interest and inspire rather than to weary and confuse. The value of the museum is thus enhanced.

PTERODACTYL, ANCIENT FLYING REPTILE
Modern birds are modified reptiles, not descended from these

The Hall of Man is not especially unique, other than in the assemblage in one place of evolutionary evidences derived from comparative anatomy, the developmental history, and the fossil record, which are usually so widely scattered that their corroborative testimony is not readily comparable. One case contains a series of casts showing the physical evolution of fossil man, while in another the cultural evolution is shown by actual material, part of the very extensive collections of prehistoric archaeology gathered mainly in Europe by G. G. MacCurdy, the Curator of Anthropology in the Museum.

This hall also contains an exposition of the so called evolutionary factors upon which the fabric of the hypothesis is based—heredity, variation, coloration, mimicry, behavior under domestication, and the like.

In three of the halls one sees many instances of the munificence of another more recent donor, Thomas Cardeza, who, in 1922, gave his entire collection of game trophies, heads, horns, skulls, and tusks to the number of several hundred. These serve admirably, not only by their decorative beauty, but by their scientific value, to supplement the older collection of mammalian life.

Above the entrance rotunda is a small hall in which the celestial phenomena are displayed in the form of illuminated transparencies of the heavenly bodies and meteorites representing a great number of important falls. These include a large series of stone and iron meteorites collected by H. A. Newton, Professor of Mathematics at Yale from 1855 until 1896 and one of the highest authorities on the whole subject of "shooting stars." Here is also a remarkable Aztec calendar stone, one of the three which are known, the others being in the Mexican National Museum and at Oaxaca.

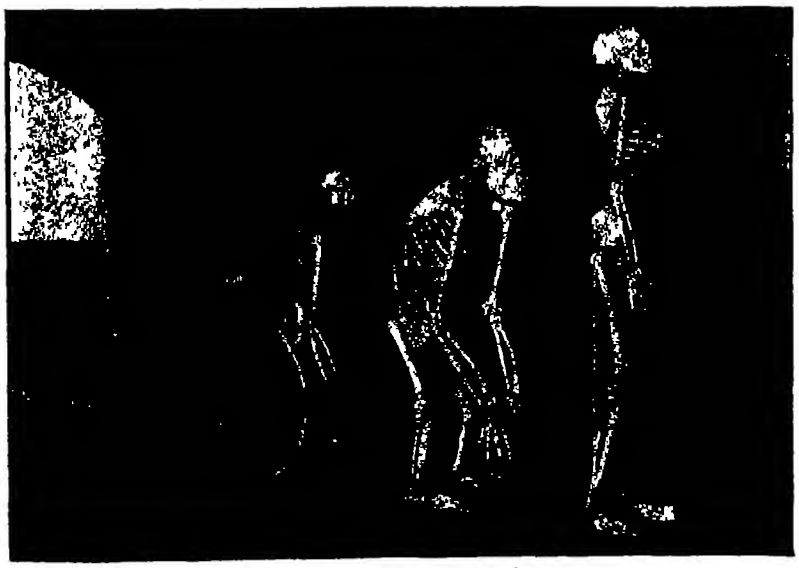
From the ceiling of this hall, through a well-like aperture, will be suspended a pendulum to repeat daily the classic experiment of Foucault in 1851 in the Pantheon at Paris and thus demonstrate visually the phenomenon of earth rotation. Farther down in the crypt beneath the entrance hall is an excellent seismograph. The importance of this, which is the second of the only two stations in all New England, is at once evident. Another hall contains about half of the great collection of minerals, some of which formed the initial gathering made by Benjamin Silliman in 1803, out of which the institution was destined to grow. The minerals are noted, not alone for the completeness of the series, and the rarity and great beauty of some of the specimens, but for the fact that here again the collection contains type material, the basis of new description and subsequent research.

There are two Halls of Zoology, in one of which the economic aspect of that science is stressed, and in the other, local associations of birds, reptiles, and other groups, including invertebrates. The Hall of Economic Zoology also has a portion set apart for the instruction of special groups of children.

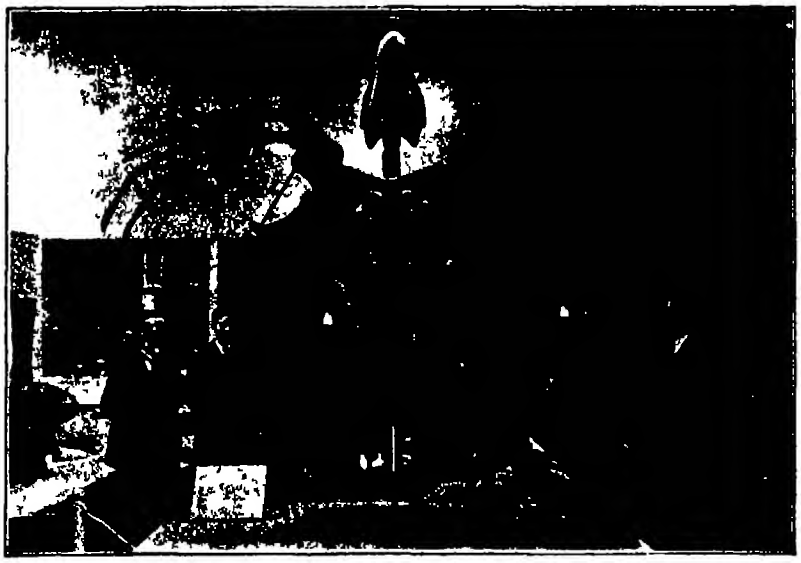
A Museum for All

Perhaps one-half of the collections pertaining to man are to be found in the hall of Ethnology, under the special care of G. G. MacCurdy, who has served as Curator since 1902. Collections of more than usual interest are here, among which are those of prehistoric objects from the Province of Chiriqui, Panama, the Beadle Collection from southern California, the Mosely Collection of Indian Basketry, the Grinnell and Bigelow Collections pertaining to the Plains Indians, and that collected by the Yale Peruvian Expeditions under the leadership of Senator Hiram Bingham. New England is also well represented, especially, and fittingly, Connecticut. A very instructive synoptic series from Europe represents the especial field of research of the Curator.

This briefly describes Yale's newly housed museum, which has already been visited by tens of thousands of people to their enjoyment, and, it is hoped, to their intellectual and spiritual uplifting. We trust that in the days to come it will prove yet more valuable to the many who are destined to come, for it holds out a welcome to all lovers of nature



PRIMATE SKELETONS IN THE HALL OF MAN
LEFT TO RIGHT. *Gibbon, orang, chimpanzee, gorilla and* Homo sapiens



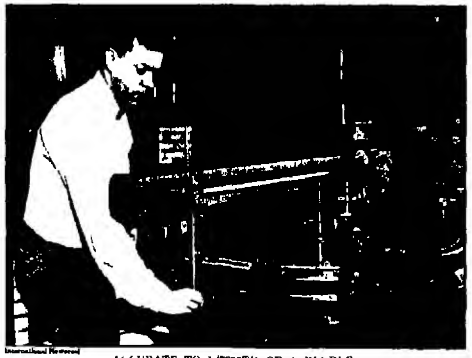
LARGEST TURTLE IN THE WORLD
Turtles evolved just before the age of reptiles, in the Permian Period

From the Scrap-book of Science—Camera Shots of Scientific Happenings


Wide World

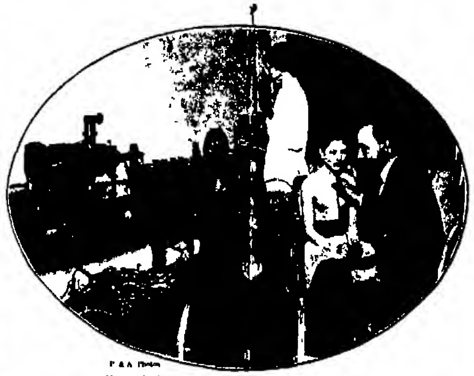
THE MASK OF TUTANKHAMEN

This covered the head and shoulders of the King's mummy. It is made of beaten gold, inlaid with lapis lazuli, felspar, carnelian, calcite, obsidian and poly chrome glass. Some of these minerals are quite rare, while others such as felspar and calcite are common place but nevertheless beautiful


International Newsreel

ACCURATE TO 1/7200TH OF A DEGREE

Dr. Lewis V. Judson of the U. S. Bureau of Standards, with a new circular dividing engine just purchased by the Bureau. It is believed to be the most precise now obtainable for the graduation of circles, being accurate to one half of one second of arc. It will be used for the graduation of precision theodolites and instruments used by various scientific departments of the Government


P. & A. Photos

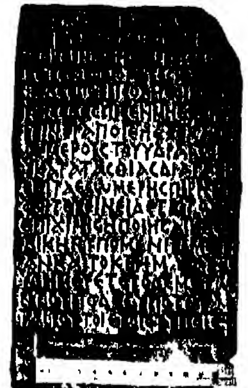
INSTRUMENT PERMITS GROUP DIAGNOSIS

The new electro-cardiograph and "radio-stethoscope" at a Chicago hospital. It records heart beats and amplifies them so that several physicians can diagnose them


Wide World

LIQUID FUEL FROM COAL

Making laboratory tests at Birmingham University, England, on the Bergius process of "liquification" of coal. Dr. Bergius, a German, claims a ton of coal will yield half a ton of oil for motor fuel, also valuable solids. The process takes place at a pressure of 1,800 to 2,250 pounds per square inch, and at a temperature of about 800 degrees, Fahrenheit


H. J. Shepstone

NO TRESPASSING

A Greek inscription of the Fifth Century recently discovered near the aqueduct which conveyed water into Jerusalem. It contains a warning, both against trespass and planting crops within fifteen "podos" (fifteen feet) of the conduit. To make sure the peasant should not plead ignorance of the distance, the foot, 12 1/16 inches long, was engraved on the stone


Courtesy of the General Electric Company

MAMMOTH TURBINE CASTING

Assembly of the casting of the low pressure element of a 77,000 kilowatt, cross-compound steam turbine. It weighs fifty tons and is sixteen feet in diameter

VACCINATING DOGS AGAINST DISEASE

Recently when dumb rabies became prevalent among dogs in San Diego, every dog in that California community had to be vaccinated against it or go to the dog pound. The needle is practically painless, yet the owner of the pet standing on the left is plainly apprehensive of trouble


P. & A. Photos


P. & A. Photos

CONCENTRATION

Tests recently made at the Department of Psychology of the University of Chicago indicated that students could think faster and more accurately when their muscles are tense

4,692 FEET PER SECOND

P. T. Russell of the Washington Navy Yard, who developed this apparatus for quickly measuring the depth of the ocean. The principle is simple. A sound is directed downward from the ship, strikes bottom and is reflected. The speed of sound in water being known, the distance of depth may easily be determined


P. & A. Photos


Wide World

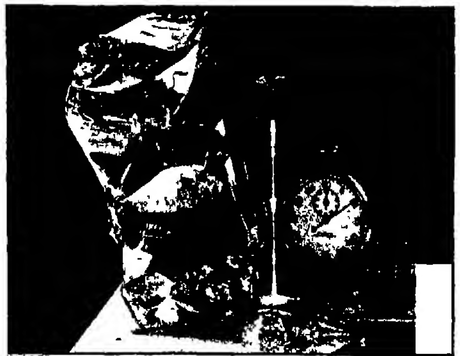
TESTING ALLOYS

The extensometer at the U. S. Bureau of Standards, Washington, D. C., testing alloys under heavy stress. The amount of distortion of the alloy may be determined within one four millionth of an inch


Wide World

UNSANITARY

Recently London workmen unearthed at a depth of three feet a wooden water pipe laid in the Seventeenth Century. It is said that such water mains spread disease


Harris & Ewing

AMERICANS LEARN TO MAKE OPTICAL GLASS

Optical glass made at the U. S. Bureau of Standards. Until the World War began, the United States imported its optical glass from Germany. With the German supply cut off, American scientists began learning to make optical glass themselves and within a few months were successful. Much optical glass is now being made in the United States. The stop-watch shown above was photographed through a piece of optical glass nine inches thick, made at the Bureau of Standards. Such a block, before grinding and polishing is shown on the left, illustrating the startling difference between the raw, unfinished material and the finished product


Harris & Ewing

UNDERSTANDS BATTERIES

George W. Vinal, Government battery expert of the United States Bureau of Standards, where he is the head of a section. His book, "Storage Batteries," is well known


P. & A. Photos

NEW WEIGHING SYSTEM FOR LOCOMOTIVES

A British device for weighing locomotives which has been installed in the King's Cross locomotive sheds in London. It consists of a small hydraulic jack which is placed in turn under each wheel of the locomotive. The several weights are then added. Some rather large locomotives are now being employed on some of the British and European railroads. Americans who used to smile at the diminutive locomotives of the Old World will now meet with frequent surprise since some of the newer locomotives weigh over 100 tons. Express trains in England average faster than in the United States, another fact which may cause some surprise


Wide World

NEW LENS FOR AIRPLANE PHOTOGRAPH

This 15 pound lens, nine inches thick, was recently made for the U. S. Army Service. Through it the city of Detroit was photographed from a distance of 210 miles. Above, the lens is compared with a pocket camera

What Asthma and Hay-fever Are

Medical Science is No Longer Baffled by These Peculiar Diseases

By Grafton Tyler Brown, B S, M D

DOUBTLESS some of the readers of the Scientific American have passed through the throes of asthma or hay fever If so they are all too familiar with the trying symptoms of itching, teary eyes, running nose, sneezing in the case of hay fever and the uncomfortable, sometimes terrifying shortness of breath in asthma cases In writing on this subject I realize that I am not treading on virgin soil, as evidenced by the increasing number of articles appearing in the lay press Unfortunately however, much that has thus been written is not true and is apt to be misleading

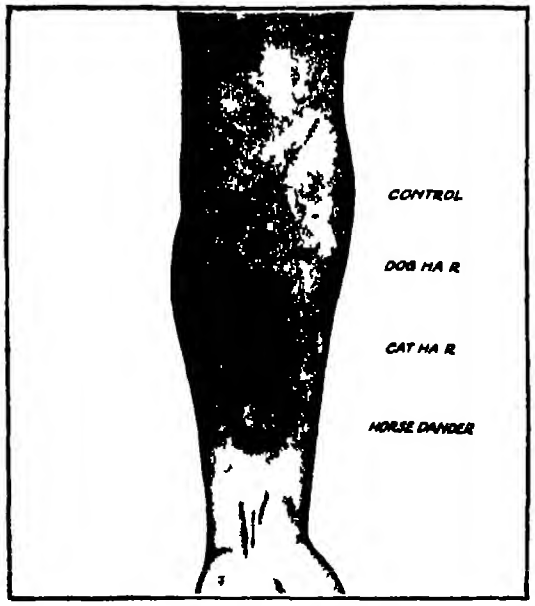
Since I am about to advocate the cutaneous or skin test for both asthma and hay fever, and the treatment of such cases by the injection under the skin of certain proteins I will explain briefly just how this treatment was discovered and how it came to be recognized by leading physicians

Anaphylaxis Discovered Accidentally

In 1902, Charles Richet injected a dog with some poisonous substance This injection had no apparent harmful effect Twenty two days later he repeated the injection, using exactly the same dose, with the idea in mind of giving gradually increasing doses in the future, and thus producing a condition of prophylaxis, or immunity, in the dog to that particular poison Much to his surprise, however, before he had hardly completed the injection, the dog was taken suddenly ill and died within 35 minutes As this condition was the exact opposite of prophylaxis, he christened it *anaphylaxis* What had happened was, that the first dose had sensitized the dog to that particular poison, while the second dose had caused sufficient shock to produce death

Animal experimentation was next carried on by different investigators in many countries, and we have thus come to know that the interesting and varied phenomena of anaphylaxis are due to sensitization to some foreign protein The first dose or injection of foreign protein, which produces the condition of sensitization, is known as the "sensitizing dose" Following the first or sensitizing dose there is what may be termed an incubation period of approximately ten days, during which the blood and tissues of the animal are endeavoring to form antibodies, in response to the stimulus of the foreign protein Any further injections given during this so called incubation period will have no effect other than to prolong the incubation period

Meltzer, in 1910, noted that during the experimental anaphylactic shock guinea pigs manifested asthmatic symptoms He suggested that asthma in human beings was likewise due to anaphylaxis or protein sensitization A guinea pig that has been sensitized to horse serum, will react to horse serum, but not to cow serum, and vice versa In other words, protein sensitization is absolutely specific When an animal is injected with a sensitizing dose of some foreign protein the form of anaphylaxis produced is known as active anaphylaxis



REACTIONS TO SKIN TESTS
The patient is being tested with the various substances indicated above The reaction to each is indicated by the appearance of the skin around its cut


SPECIMENS OF RAGWEED
These plants Ambrosia trifida *and* Ambrosia artemisiaefolia *are often the cause of asthma and hay fever, although they are not always the offenders*

Sensitivity is Transferable

If some of the blood serum from a previously sensitized guinea pig is injected into a normal guinea pig the sensitization to that particular protein will be transferred to the second animal, and an exciting dose of the specific protein given immediately to the second animal will cause anaphylactic shock This is known as "passive" anaphylaxis Considering the great number of blood transfusions that are being performed, the transference of sensitivity from one animal to another is of considerable clinical importance Therefore, in addition to the routine examination (Wassermann, blood grouping, et cetera) to which donors for transfusion are subjected their history, with regard to any possibility of anaphylaxis, should be very carefully gone into and if such a possibility is indicated, tests for protein sensitization should be made

At this point it may well be emphasized that previous to the administration of diphtheria antitoxin, the patient's history should be carefully gone into, and if there is any evidence of sensitization, a test with horse serum protein should be performed, particularly if the patient is an asthmatic Neglect to do this may result in severe anaphylactic shock, or even death

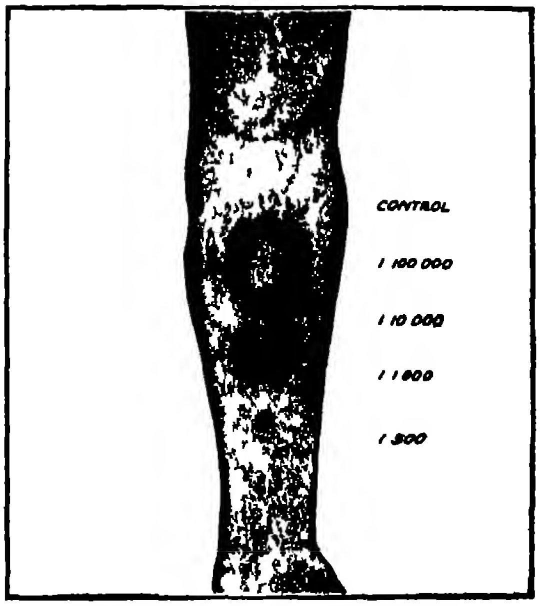
Oscar M Schloss, in numerous painstaking experiments on children who had idiosyncrasies to various articles of food, brought anaphylaxis out of the field of animal experimentation, into that of practical clinical medicine He was the first to establish that it was the protein in the food that was the offending element and that all the other constituents were harmless Secondly, he proved that this idiosyncrasy or hypersensitiveness to some particular food protein was absolutely specific Thirdly, he demonstrated that the offending protein could be detected by the cutaneous or skin test, which I will explain at greater length in a subsequent paragraph. Sensitization in human beings is known as *allergy*.

Making the Diagnosis

The revolutionary nature of the work just described may be appreciated when we realize that, previous to the advent of protein sensitization, asthma was considered an incurable disease of unknown cause It can be proved that about one half of all cases of asthma are due to sensitization to some foreign protein Asthma cases are therefore grouped into two classes first, those which are found sensitive to some foreign protein, which are designated as true bronchial or allergic asthma, second, those which are not found sensitive to any foreign protein, which are designated as asthmatic bronchitis The sensitive asthmatic can usually be completely relieved of all attacks by elimination of the offending protein or proteins from this diet or environment, by specific protein treatment or proper vaccine treatment, or by a combination of these

It is my opinion, too, that a considerable proportion of the so called "non sensitive" or asthmatic bronchitis cases are also due to sensitization to some foreign protein, or perhaps some non protein substance, and that we have merely failed to detect the offending protein or other substance and it has been my experience that the majority of them can be relieved by proper vaccine treatment

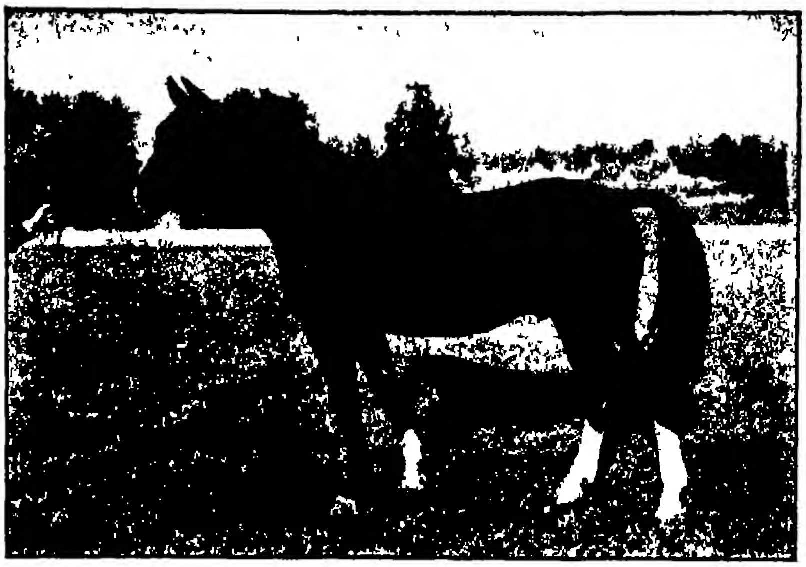
Asthma may be due to sensitization to any foreign



DETERMINING DEGREE OF SENSITIVITY
The reactions to varying dilutions of dog hair protein extract when applied to the author's arm The strength of the solutions are shown beside the arm

THE HOUSE CAT MAY BE A SOURCE OF DANGER

Dandruff from cats is often found to be the cause of hay fever and asthma Cures are then made possible by the removal of the source, often household pets Then the treatment outlined in this article may be applied by a doctor



EVEN "OLD DOBBIN" IS UNDER SUSPICION

People who have to work around horses, or even those who are in occasional contact with them, often contract asthma or hay fever from the dandruff of the animal It is wise for all sufferers from these maladies to keep away from animals

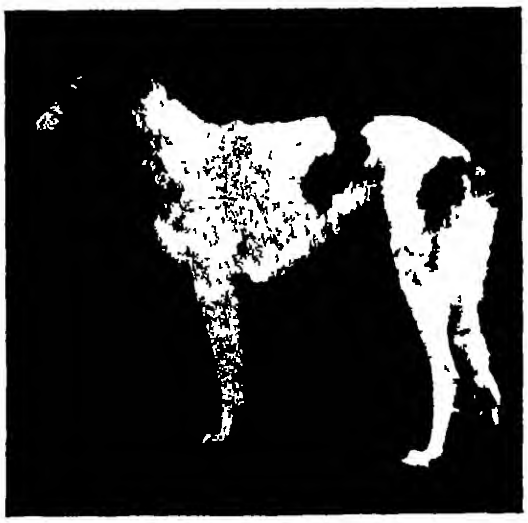
protein with which the patient comes in contact The offending protein may enter the body by inhalation, ingestion, absorption or infection. Inhalation applies to the proteins of plant pollens, of animal emanations, such as hair, dandruff, feathers, wool, and of miscellaneous inhalants such as orris root, et cetera Ingestion and absorption apply to food proteins. Absorption may also take place through the membrane which lines the eyelids, the nasal mucous membrane, or, in rare cases, even through the unbroken skin The word *infection*, however, applies to bacterial proteins (This is a good place to emphasize the fact that bacteria may act in two ways. first, as a typical infection, with the formation of toxins, or poisons, and second, the patient may be sensitive to the proteins contained in the bodies of the bacteria)

How Diagnosis Is Made

The diagnosis of the offending protein or proteins, in the individual case, is made by means of the cutaneous test, the technic of which is as follows both arms of the patient are bared to the shoulder and extended, with the palms up, upon a table adjusted to the proper height The flexor surfaces of the upper arms and forearms are then cleansed with 50-percent alcohol A series of linear cuts about one-eighth inch long are made with the tip of a fine scalpel This is practically a painless procedure. These cuts should be about one and one half inches apart and should penetrate the outer layer of the skin, but not deep enough to draw blood, other than the mere trace, which is often unavoidable I usually make eight cuts on each arm, four above and four below the elbow To each of these scratches, with the exception of the ones just below the elbow on each arm, which should be kept as controls, is applied a small quantity of purified powdered protein of the substances to be tested To each of these is then added a drop of tenth-normal (0 4 percent) sodium hydroxide in order to dissolve them and to permit rapid absorption A drop of the solvent is also applied to each of the control cuts After 30 minutes, the proteins are washed off and the reactions are interpreted.

A positive reaction occurs in from five to 30 minutes, and is indicated by a definite urticarial wheal (or hive) about the site of the cut, at least one-quarter inch in diameter, surrounded by an area of more or less redness These reactions give no sore arm or allergic shock, even in a very susceptible patient, as the protein may be washed off at any time, thus checking its action. Larger reactions than one quarter inch are denoted by a series of plus marks, and smaller ones are called doubtful These doubtful reactions should not be ignored, but should be looked upon as danger signals and repeated at some future time. In some cases a positive reaction is indicated by a large red area, with no wheal formation With bacterial proteins, there is still a third form of positive reaction, which appears hours later, the site of the inoculation being elevated, hot, inflamed, and slightly painful, having all the appearances of a mild infection Unless attention is paid to these delayed reactions, a number of positive reactions will be missed Occasionally, food reactions do not appear until several hours after the tests are made

To determine the degree of sensitivity of a patient, I make tests with varying dilutions of the offending protein, namely, 1 100,000, 1 10,000, 1 1,000 and 1 500 Treatment is started with the strongest solution which fails to give any skin reaction whatsoever Asthmatic patients are tested in a routine manner with all food proteins which enter into their daily diet, as well as with the hair or dandruff of such domestic animals as are about the home or place of occupation Seasonal, or hay asthmatics, should be tested with pollen proteins Those asthmatics who are susceptible to colds, as well as those who do not react to any other form of proteins should be tested with bacterial proteins The more proteins that are tried, the more certain one can be of the diagnosis, namely, that all offending proteins have been detected I use some 280 different proteins, and am continually adding to this supply



INFECTION FROM DOGS

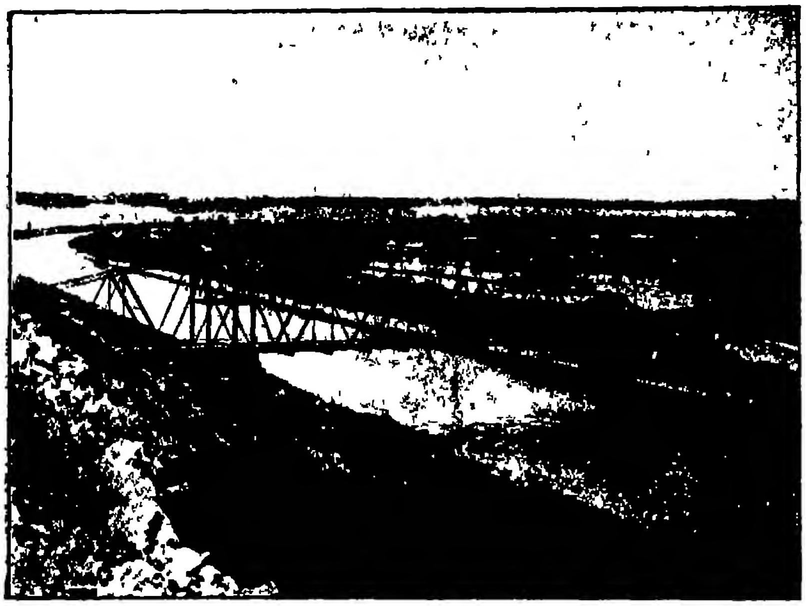
Both hay fever and asthma may be contracted from the dog However both diseases will usually yield to the proper treatment

And now we come to a human ailment perhaps more commonly encountered than is asthma—namely, hay-fever, known, in medical terms, as a typical clinical manifestation of *allergy* Seasonal hay fever is nearly always due to sensitization to the proteins of plant pollens, whereas non-seasonal or perennial hay fever may be due to sensitization to any foreign protein There is also a form of perennial hay fever due to a deficiency of calcium (lime) in the system which can be detected by a special blood test and corrected with proper treatment Summer hay fever is commonly spoken of as "rose cold," which is a misnomer, as most of these cases are due to sensitization to one or more of the grass pollens. Roses are insect pollinated, and do not cause symptoms except on intimate exposure, even in sensitive patients The typical fall hay-fever season is from about the middle of August until the first frost, which coincides with the period of pollination of ragweed, to which pollen practically all of these cases are dominantly sensitive

The Best Treatment is Prevention

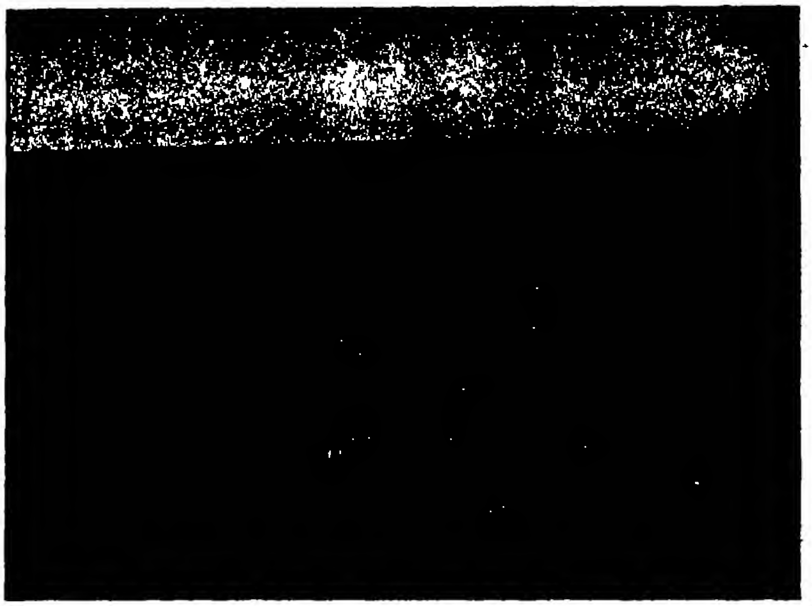
Undoubtedly the ideal method of treating seasonal hay fever is pre seasonal treatment started far enough in advance of the season to get the patient as completely desensitized as possible just before pollination of the particular offending plant or plants. In those cases in which pre seasonal treatment is incomplete, or in which there has been no pre seasonal treatment, co seasonal treatment is well worthy of trial Pre seasonal treatment is given at weekly intervals, unless the time is limited, in which case the interval between treatments may be lessened, especially on the smaller doses Co seasonal treatment, on the other hand, is preferably given at irregular intervals, depending upon the duration of relief following the individual treatment

The pollens are grouped biologically or botanically into a number of groups, as follows *Gramineae* including the grasses such as timothy, red top orchard grass, June grass, sweet vernal grass, and the cereal grains such as corn, rye, wheat, and so on, *Compositae*, such as short ragweed, giant ragweed, dahlia, sunflower, golden rod daisy, aster, and so on The patient should be tested with the pollens to which he is exposed, and should be treated with the pollen or pollens which give the dominant reactions in any particular group



A STRETCH OF THE DRAINAGE CANAL

This canal 21 4 feet deep, 28 miles long—extends from the Chicago River to the Des Plaines River and carries Chicago's sewage The bridge is one of many such structures



NORTH SHORE SEWAGE TREATMENT PLANT

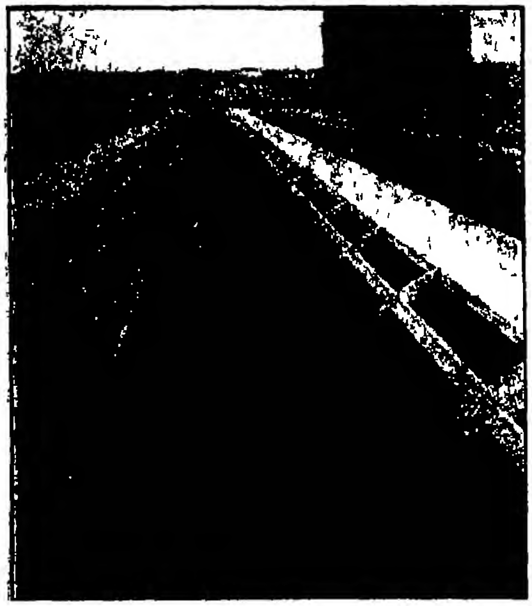
A battery of twenty four tanks, in which the sewage is aerated by forcing compressed air up through the liquid This serves to oxidize and render innocuous the remaining impurities

World's Largest Sewage Disposal Problem

Chicago's Great Effort to Purify Sewage and Factory Wastes, Equivalent to That of a Population of Five Million People, by Modern Methods of Tank Treatment

THE Great Lakes are an average of 25 inches below their normal levels. As we showed in our September issue, five inches of this deficit is due to Chicago drawing water from Lake Michigan through its Drainage Canal, and 20 inches is due to shortage of precipitation and a rate of evaporation which lately has been above the average. The canal takes water from Lake Michigan at the rate of 8,500 cubic feet per second to dilute the sewage of Chicago, which is carried by the canal and discharged into the Mississippi Basin

Chicago is equally concerned with the other Great Lakes cities and the shipping interests over the serious lowering of lake levels, and its municipal authorities are fully alive to the fact that their permit to drain water out of Lake Michigan is not permanent but is revocable at any time by its grantor—the Federal Government Hence, for several years, the city has been at work investigating, planning and building in the effort to find some other method of disposing of its sewage The work is in the hands of the Sanitary District of Chicago, which proposes to use the well proved system of tank treatment by which from 90 to 95 percent of the impurities can be removed from the sewage and the purified water or "effluent" discharged into the Drainage Canal



ONE OF THE AERATION TANKS

Air is supplied by the pipe at bottom of the tank

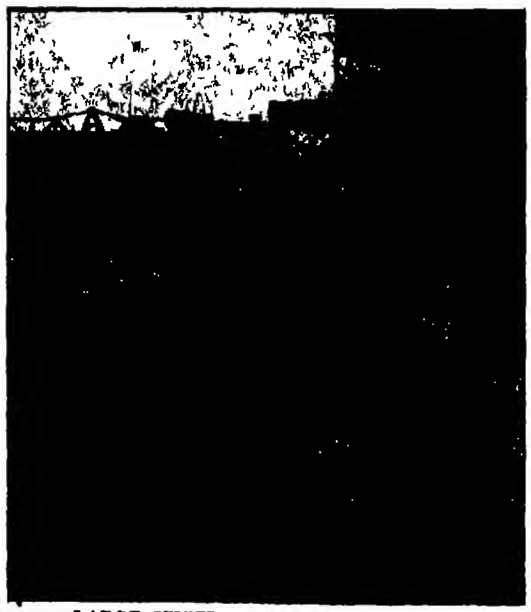
Sewage Disposal in 1850

Ninety years ago, Chicago was a village situated on marshy land at the southwest end of Lake Michigan. Its water supply was obtained from wells In 1851, municipal operation of the water works was undertaken and sewage was discharged into the Chicago River and carried into Lake Michigan. If we may judge from the following extract from a local paper in the summer of 1850, it was high time that something be done·

"The wonder is not that we have had cholera in our midst for two seasons in succession, and that the common diseases of the country are fatally prevalent during the summer months, but that a worse plague does not take up permanent residence with us. Many of the populous localities are noisome quagmires, the gutters running with filth at which the very swine turn up their noses in supreme disgust Even some portions of the planked streets, say, for instance, Lake between Clark and La Salle, are scarcely in better sanitary condition than those which are not planked The gutters at the crossings are clogged up, leaving standing pools of indescribable liquid, there to salute the noses of passers-by There being no chance to drain them properly, the water accumulates under the planking, into which flows all manner of filth, and during the hot weather of the last few weeks, the whole reeking mass of abominations has steamed up through every opening, and the miasma thus elaborated has been wafted into the neighboring shops and dwellings to poison their inmates."

The Sanitary District has grown with the growth of the city Within its area of 437 39 square miles is included all of Chicago (199 38 square miles) and some 49 other incorporated cities and villages. At the time of its formation in 1890, the area of the district was 185 square miles and the population was 1,149,738 In the year 1925, the population had risen to 3,350,000 and the area of the Sanitary District was 437 39 square miles. As we said in our last issue, it was the pollution of the lake, with its threat to the inhabitants of Chicago who were drawing their drinking water therefrom, that led to the construction of the Drainage Canal and the reversal of the flow of the Chicago River.

Permission of the Federal Government to open the canal was granted May 9, 1899, with the expressed stipulation that the permit was temporary and revocable at will. On December 5, 1901, the Federal Government restricted the rate of flow through the canal to 4,167 cubic feet per second throughout the 24 hours of each day. Subsequently, various efforts were made by Chicago to secure permission to take a larger amount of water from Lake



LARGE SEWER AT THE STOCKYARDS

This shows construction of a sewer for waste material

Michigan, culminating in an attempt to secure congressional authorization for a diversion of 10,000 cubic feet per second. The Federal Government has always admitted the necessity for Chicago to take some water from the lake, and the controversy was finally settled on its present basis, by which Chicago is permitted to withdraw an average of 8,500 cubic feet per second, on condition that she provides sewage treatment plants sufficient to handle the sewage of an additional 300,000 people each year for a period of five years.

This permit by the Secretary of War, dated March 3, 1925, reads as follows: "That the Sanitary District of Chicago shall carry out a program of sewage treatment by artificial processes, which will provide the equivalent of the complete (100 percent) treatment of the sewage of a human population of at least 1,200,000 before the expiration of the permit" Another section obligates the Sanitary District to pay its share of the cost of regulating or compensating works to restore the levels or compensate for the lowering of the Great Lakes system, and to post a guarantee of 1,000,000 dollars as evidence of its good faith. This last requirement has been met. The execution of the sewage treatment program is under the supervision of the United States District Engineer at Chicago Another and most important clause obligates the city to adopt a program for metering at least 90 percent of its water service. If the city fails to do this, the permit may be revoked without notice

800,000,000 Gallons of Water a Day

This last clause brings up a most important question in the matter of the use of lake water It seems that the present average consumption of water in Chicago is enormous—800,000,000 gallons per day, the per capita consumption being about 275 gallons per day. For this purpose Chicago pumps from the lake more water than is supplied to Greater New York, Milwaukee, Cleveland and Newark combined, although the total population served in these four cities is nearly 7,500,000 The Western Society of Engineers, after a study of this subject, stated that metering the water supply of the city would reduce the daily per capita consumption from 275 to about 125 gallons and would result in a saving in the construction of new plants of 88,000,000 dollars in the next 25 years, and a saving in operation costs of 145,000,000 dollars. Reduction of the water consumption, moreover, would bring about a large reduction in the amount of sewage. The engineers of the Sanitary District estimate that this decrease would reduce the cost of future projects by 25 percent Furthermore, the saving in pumping costs, resulting from metering, would finance a complete filtration system for the city With the adoption of metering, it will be possible to complete the treatment program of the Sanitary District by 1940 instead of by 1945, as is now planned by the trustees. This can be carried out with a water diversion from Lake Michigan of not more than 8,500 cubic feet per second, gradually reducing to 4,400 cubic feet per second or less, as the treatment plants are installed

The present population of Chicago is 3,426,000, but in addition to treating the sewage due to population, it will be necessary to handle also the industrial wastes from the packing houses and from the food products concerns. These wastes are estimated to be equivalent to the sewage from a population of 1,620,000, so that the total equivalent population in the present year is 5,046,000 As the result of the studies of sewage treatment, six major treatment projects have been outlined, in addition to several small projects for outlying towns and villages. This great work has been under way for several years and the total expenditures on sewage treatment up to January 1, 1923, were 21,254,368 dollars. The construction program from 1923 to 1945 calls for an ultimate expenditure of 116,209,000 dollars


DRAINAGE CANAL LOCK AT LOCKPORT
At the further end of the Canal are a lock, an electric hydraulic power plant, and regulating works to control the flow of water from Lake Michigan

We present several views of the North Side plant which serves a population of 800,000, and on its completion will be the largest "activated sludge" plant in the world For the construction of the plant, a tract of 180 acres of land was acquired in 1921. The contract for the construction of the North Side aeration and settling tanks was entered into August 9, 1923, to the amount of 5,602,635 dollars. The estimated cost of the completed treatment plant is 13,500,000 dollars. In addition to the treatment works, it has been necessary to construct about 14 miles of sewers ranging in size from four feet to 18 feet in diameter—the total cost of which will be over 10,000,000 dollars

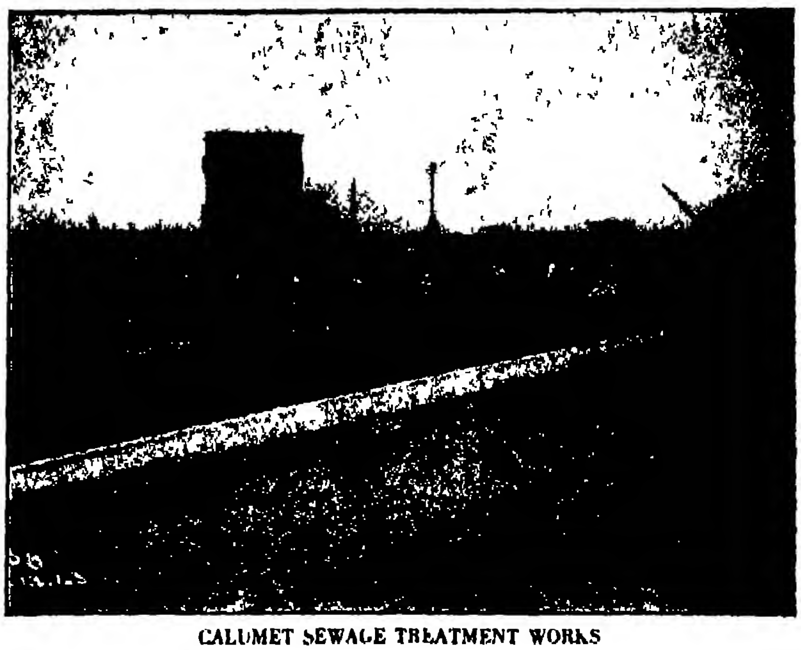
When the sewage reaches the North Side plant, it is treated in settling and aeration tanks of the kind shown in our illustrations. The settling tanks are large rectangular basins—the floors of which slope gently to the center. Suspended within the tank from an overhead bridge is a vertical shaft, electrically driven, which carries four radial arms, the bottoms of which conform to the slope of the floor Attached to the bottoms of these arms are a number of inclined vanes or ploughs, which gradually sweep the sludge to the center of the tank, whence it is removed, by pumping, to the sludge beds.

How Impurities Are Rendered Innocuous

The sewage is also treated in a vast system of aeration tanks of the kind shown in our illustrations These tanks, which are of concrete, are built in batteries of 24 each Extending along the bottom of each tank is a large pipe through which compressed air is discharged into the sewage toward one side of the tank The air rushes up through the liquid material and maintains a constant and violent circulation of the sewage, which is caused to flow up on one side of the tank and down on the other The sewage is thus thoroughly aerated and the process of oxidation renders innocuous the impurities remaining after the heavy solid matter has been deposited.

One thousand pounds of coal per minute! This is the quantity of fuel that the largest single-unit machine in the world will consume. In our November issue, we will describe this giant of power and present several photographs of it


ONE OF THE SETTLING TANKS
In these tanks the solids settle out of the sewage The four rotating arms rake the sludge in to the center, from which it is drawn off by pumping


CALUMET SEWAGE TREATMENT WORKS
The solids which are deposited in the settling tanks are pumped to these sludge beds, from which they are removed and used as fertilizer

Novel Devices for the Shop and the Home

A Department Devoted to Recently Invented Mechanical and Household Appliances

Conducted by Albert A Hopkins

A vacuum cup holder for keeping the shaving brush in its place

An Efficient Brush Holder

A VACUUM cup holder into which any shaving brush will fit is illustrated here It prevents the brush from falling into dirty corners or on dusty floors It will hold it on porcelain, marble, wood, or other material

Woodworking at the Bench

SOME months ago, we illustrated a very clever little shaper which can be used on the bench or on the actual work, and we now show another member of the family This machine is driven by a one quarter horsepower motor and can be used as a bench shaper, portable shaper and small jointer As a bench shaper, all kinds of small and medium-sized work can be done quickly and without expensive help As a portable shaper, much work can be done on pieces after assembly as well as on pieces too large to be handled easily The motor side of the table is provided with two handles for use of the table with motor as a portable shaper The ability to set the motor shaft at various angles makes possible the use of cutters of smaller diameter which take much less power

A Mechanical Caddie

TO eliminate the drudgery of carrying a heavy bag of golf clubs a carrier on wheels has been invented capable of taking care of one or two bags The bag is kept clean and the clubs are kept together thus saving them from being scratched and marred by knocking together as they do when carried in a caddie bag. The carrier can be wheeled on the greens without marring the grass.

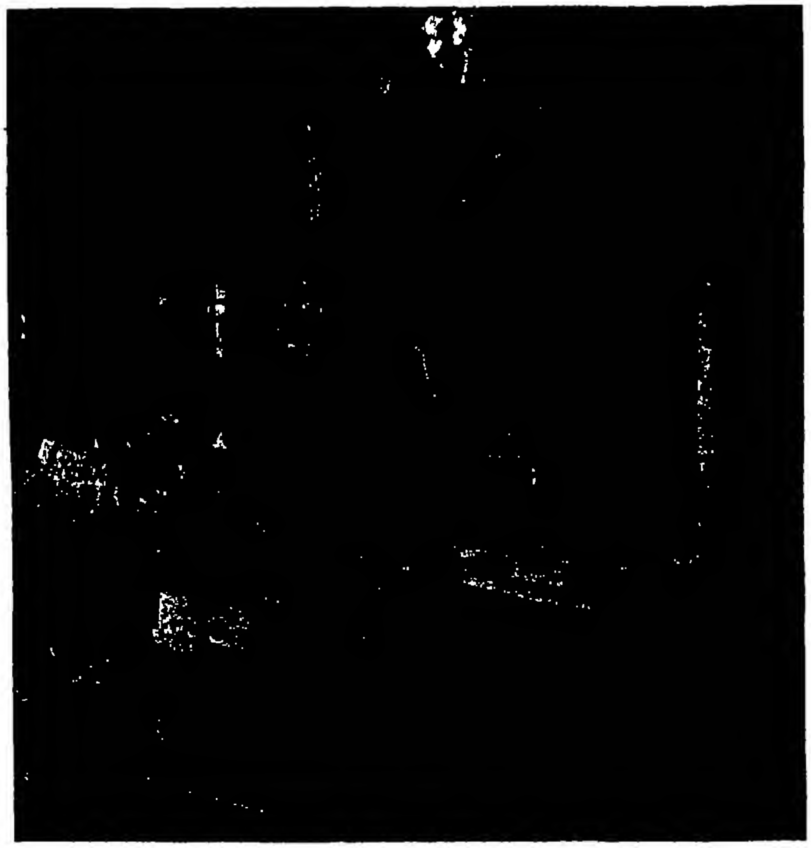
A combination bench and portable shaper table. This machine is driven by a one-quarter horsepower motor

For the caddie-less golfer

Air Suction Comes to the Aid of Scale

A DETROIT inventor has devised a simple and automatic weighing machine in which the excess material is removed by air suction The illustration shows the construction. The material is fed from the storage hopper into the machine hopper by ratchet feed This is so connected as to stop feeding when the worm is stopped thereby controlling the amount fed to the worm A vibrator serves to disturb materials that cake or pack and cause the same to fall continually on the worm When the motor is started by throwing the switch, the fan, vibrator and other parts of the mechanism begin to function under control of the weighing device An electric button is pressed which closes a switch and makes connection with a solenoid

This solenoid throws a clutch, sliding on a worm shaft, into mesh with another clutch, which is continually turning. At the same time, connection is made with a solenoid which opens the door at the end of the worm With the worm feed turning and the door opened, the material is forced into the holder on the scale until the amount set to be weighed causes the scale-arm to go up and make contact. This contact closes a circuit and causes another solenoid to throw out the clutch and closes the door tight. The worm is stopped and the door is closed; no more material can be put into the holder on the scale When the contact on the scale arm is made, a very small solenoid opens the shutter in the air-suction pipe and permits suction of the excess material (one or two ounces) from the holder until the scale arm descends to perfect balance when contact is opened or broken and the shutter closes. The material now weighed is dumped by opening the shutter at the bottom of the holder



Continuous controlled scale for weighing dry materials

A table toaster which cuts off the heating current automatically

Automatically Controlled Toaster

WE have all seen the automatic toasting machine in restaurants and the sandwich shops which are springing up all over the country These toasters are too large for home use but now we have a device which can be placed on the dining room table This little brother of the restaurant toaster turns out the same brand of golden brown toast with no burning. You simply drop the bread into the oven slot and depress the two levers. When the toast is done, up it comes and the current is automatically cut off

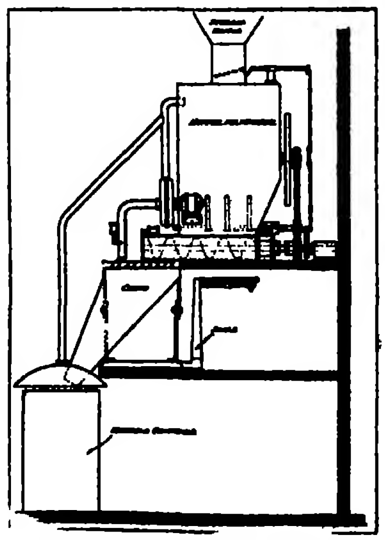


Diagram of the scale mechanism


Observatory time from your electric house-lighting circuit

"Telechron" Clocks

A NEW kind of timepiece has recently been placed on the market commercially, although the principles have been known for several years. This clock has been tested out in the laboratories of a number of universities and gave excellent satisfaction. It is merely necessary to plug into the alternating current and then set the clock accurately. The correct time can be obtained from the power house.

Technically, the Telechron clock—which name means time from a distance—contains a diminutive synchronous motor which has a rotor the size of a ten-cent piece. This rotor floats in oil and makes exactly 3,600 revolutions each minute when it is connected to 60-cycle alternating current. Through suitable gearing, this is reduced to one revolution per hour for the minute hand, and the necessary amount for the hour hand. The 60 cycles is accurately controlled at the power house and checked up twice daily by the Naval Observatory.

Locking the Lock

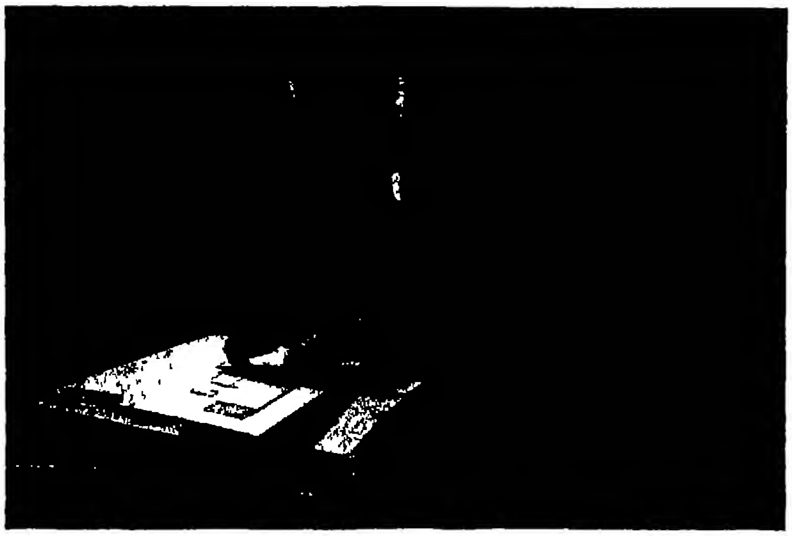
THE attachment illustrated is intended to safeguard the none too safe mortise lock by preventing the lock from being picked. The guard is made of spring steel and has two prongs and two holes. The operation is as follows.

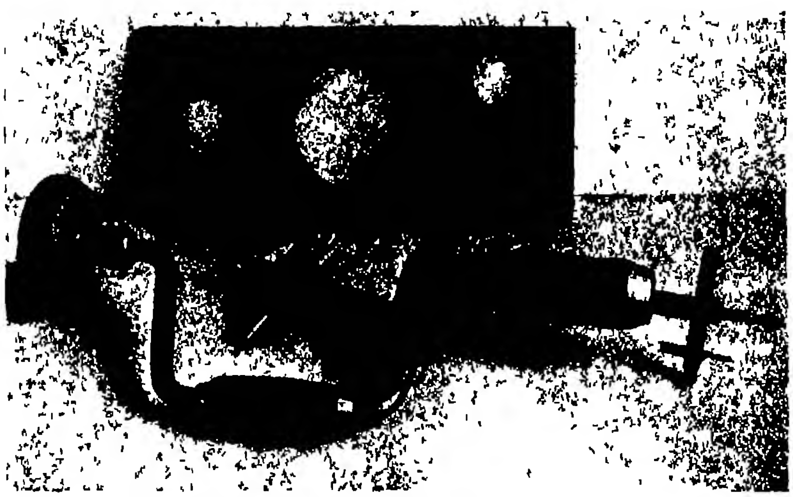
First open the padlock and insert the yoke in the hole on the guard, then snap shut and the "Keelock" is ready for use. After the door has been locked in the usual manner, remove the door key and insert the locking dogs into the keyhole, pushing the guard in as far as possible until the locking dogs expand and take a secure grip on the inside of the door plate. The door is now securely double locked. Any attempt to remove the guard by force will only cause the locking dogs to take a more secure grip on the lock. To open the door, unlock the padlock by means of its own key and remove the same from the guard, a slight push will force the guard through the keyhole to the inside of the door.

A Third Hand for the Draughtsman

THE magnetic T-square is identical with the ordinary T-square except that in


Guarding the keyhole

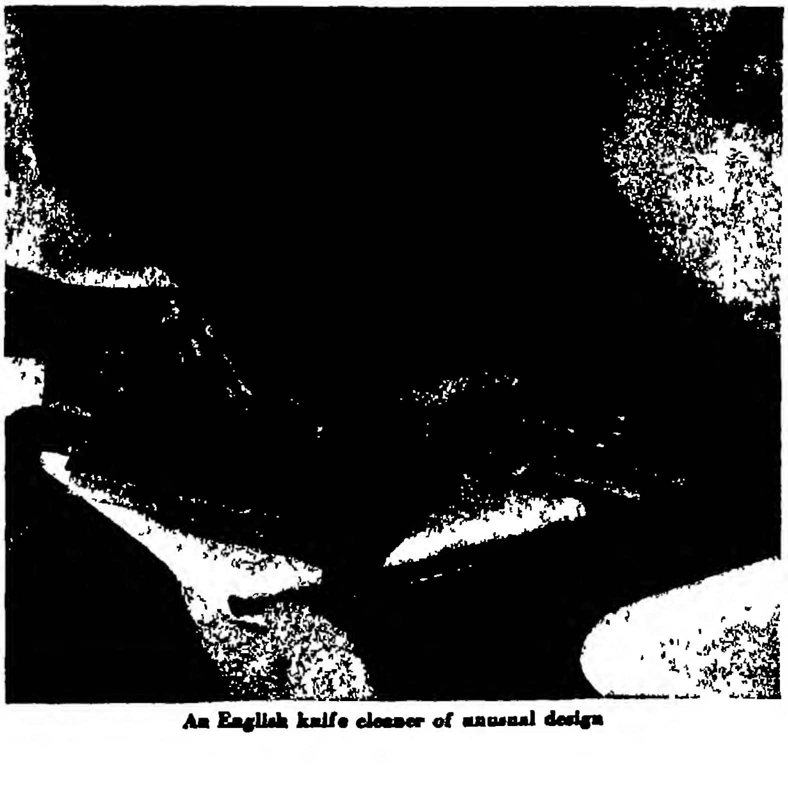

A magnetic tee square for draughtsmen

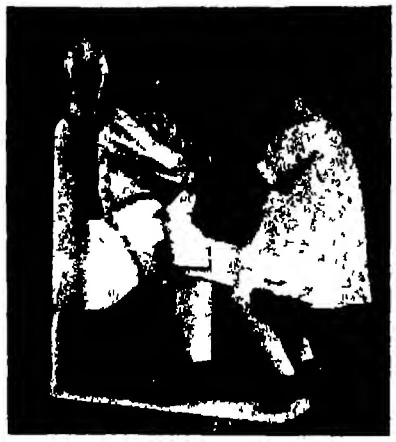

Circle cutting tool that may be used for many materials

place of an ebony or rubber head, this square is provided with a stainless steel magnetic working head. The drawing board must have, of course, a metal edge, therefore a nickelled steel working edge is provided. The T-square remains in exactly the position it is left. This device comes from England and really gives the draughtsman a reliable third hand.

An Indoor Seesaw

FOR children who are confined to apartments and have small space for play there has been invented and placed on the market recently an indoor teeter that is operated by springs. It is called the "Foxy Grandpa Bouncer," and requires only a few feet of floor space. However, it provides much amusement for the children.


An English knife cleaner of unusual design


The Foxy Grandpa Bouncer

A Circle Cutter

THE device illustrated is not limited to cutting circles in bakelite, rubber, fiber et cetera for radio panels, but can be used to cut veneers, very hard woods and soft metals as well as gaskets, washers, rings and the like from leather, linoleum and sheet packing. The construction is clearly shown in the illustration. A carpenter's brace may be used.

When desired for radio work the cutting tool is set for the size of the holes desired, then the beading tool is set with the inside edge the same size as the hole cut. This will put a full bead around the hole. To cut thin metal, reverse the cutting edge of the tool bit as the back has a knife-like edge. The tool has been christened "Panwood."

Brighten Up Your Knives

THERE is in New York, a store that is the Mecca of all those who are interested in household inventions, particularly those used in the kitchen. Every summer, one of the owners goes to Europe and brings back quantities of novelties. The knife cleaner illustrated is one of these novelties. This hails from England and seems to be a hard pad of an abrasive substance provided with a convenient handle. It cleans the knives perfectly with a minimum of effort.

A Curious Clock

A VETERAN in a hospital at Augusta, Georgia—Mr. Valter Davis—sends us a photo of a clock he has made in his spare hours, and he probably has many of them. The clock has a single hand and a 24-hour dial. The dial is divided into halves. The upper half represents the 12 hours of night (more or less) and the lower half the 12 hours of day. The painting is appropriate to the periods noted. The works of this clock were made from the parts of an old steam flow meter.


A clock made by a veteran

Courtesy Radio Corporation of America

The super-panatrope transmitting device in duplicate

The super-panatrope reproducing device is also in duplicate

Giving the Chorus Girl a Lift

"GENTLEMEN prefer Blondes" is the name of a well known play and probably gentlemen do and so do theatrical producers but they like them to sing also. But these exponents of pulchritude are not always singers—more is the pity. Mr. Ziegfeld noticed this and called on science to make up this deficiency of nature. The research laboratories of a great phonograph company and a great radio corporation were appealed to and the engineers produced what is called the super-panatrope which has been in use at the Globe Theatre in one of Mr. Ziegfeld's Revues wherein as usual he glorifies the American girl.

The electrical voice capable of rendering vocal or instrumental selections throughout the entire range of the musical art is made possible by a colossal sound reproducing device known as the super-panatrope. It is in fact a larger replica of a similar device now available for home use and likewise operates from electrically cut disks produced by the precise light ray process. The twists and turns of the record groove are translated into corresponding ripples of an electric current by a magnetic pick-up device. The electrical ripples in turn are stepped up or magnified hundreds of thousands of times by an electrical amplifier and then passed to a cone reproducer which vibrates accordingly and furnishes a faithful rendition of the original musical values recorded in the phonograph company's studio.

The reader has doubtless often noticed a certain weakness in the finale of a scene where the chorus does not match up to the exigencies of the cast and in some instances extra musicians are brought into the orchestra to help along the final crescendo. With this electrical voice the burden of the vocal rendition by the chorus may be entirely eliminated leaving the chorus girls free to concentrate their efforts on dancing or acting. So realistic is the electrical voice that the audience is virtually convinced that the chorus girls are doing all the singing.

The sound reproducing process starts with the record. Resting in the groove of the record is a needle which wobbles in accordance with the serpentine path of the groove and transmits these gyrations to an electro-magnetic pick-up which in turn translates them into corresponding electrical impulses which are amplified hundreds of thousands of times and turned over to a large cone reproducer.

In the theatre installation the mechanism is placed beneath the stage or in some other convenient place while the cone reproducer usually in duplicate is placed in the theatre such as in the apron of the stage facing the musicians. An operator stands by the mechanism placing the records, replacing them and making the necessary adjustments.

In order to provide positive performance the equipment is supplied in duplicate throughout. Thus there are two records, two turn tables, two magnetic pick-ups, two low-power amplifiers, two high-power amplifiers, two power supplies and two reproducing cones. Any combination of components from either complete set is instantly available. Duplicate records are set at the exact same point with relation to the pick-ups, revolve in absolute step and are ready to produce the exact same note in the changeover.

At the pressing of a button the orchestra leader sets the electrical voice in operation and the leader is in constant touch with the operator who sets and adjusts the mechanism by the aid of a microphone and a loudspeaker. The operator himself is also informed of everything that goes on in the orchestra by the same means. Our illustrations show the apparatus below the stage and also the two reproducing cones in front of the footlights. These are cleverly masked. Were it not for the volume control in the hands of the orchestra leader the giant electrical voice could readily drown out the orchestra and chorus. One other illustration shows the 250 watt vacuum tubes—the equipment being somewhat similar to the better type of broadcasting stations.

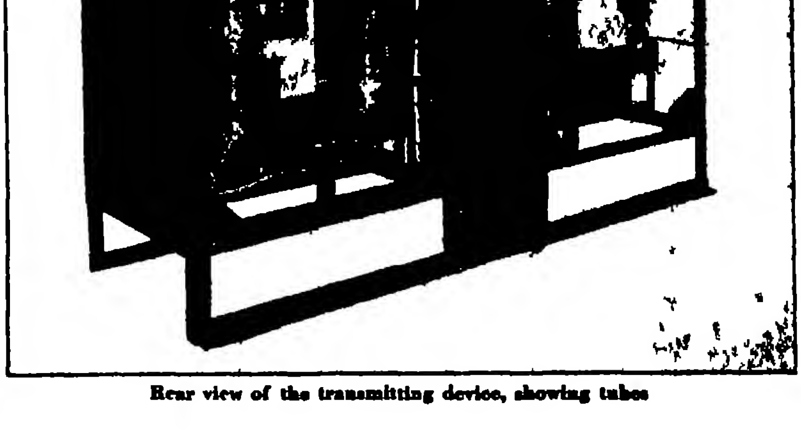
A Small-sized Electrical Refrigerator

THE small refrigerator illustrated embodies all the characteristics of the larger models—the refrigerating mechanism being contained in one unit. The motor compressor and all moving parts are hermetically sealed in a compact steel case containing sufficient refrigerant and lubricating oil to last years of service. The location of the refrigerating mechanism on top of the cabinet makes possible the elimination of all surface valves and pipe connections. The heat generated in compressing the gas rises away from the cabinet instead of enveloping it.

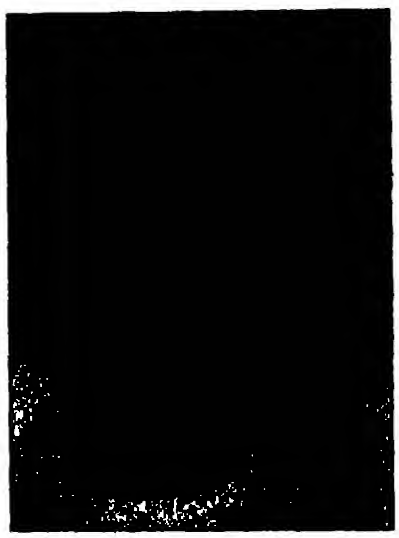
A Coffee Filter for Any Coffee Pot

THE coffee filter illustrated fits any metal coffee pot, percolators included. The water is boiled and poured through thus making what is called "drip coffee" which is considered the most delicious. The device consists of a bag fastened to a ring and a clip which serves to secure it to the top of the coffee pot.

The electrical ice man



Rear view of the transmitting device, showing tubes



Brewing coffee easily

The Scientific American Digest

A Review of the Newest Developments in Science, Industry and Engineering

Conducted by Albert G. Ingalls

Mastodon or Mammoth?

How many of our readers can identify the tooth and fragment of a tusk shown in the illustration on page 290? This photograph was submitted to us by a reader in Sweetwater, Texas. He states that the tooth is that of a mastodon. Is he right?

During the Ice Age—which came to a gradual close in the northeastern part of what is now the United States about ten or twenty thousand years ago—both the mammoth and the mastodon ranged over immense and overlapping areas near the great glacial cap, and far to the south of it. Both animals left their remains in large numbers. Their fossils have been found in many places. While these fossils are not exactly commonplace, neither are they rare. For example, 115 mastodon and mammoth remains are listed from various parts of the state of New York, in New York State Museum Bulletin Number 241 242, entitled "The Mastodons, Mammoths and other Pleistocene Mammals of New York State."

Concerning the fossils which we have suggested that the reader try his skill in identifying, their discoverer writes, "I enclose a photograph showing a section of mastodon tusk and a big tooth belonging to another mastodon, or to some other animal of sizable proportions found in gravel pits near Sweetwater, Texas. The tusk was taken out intact, but rapidly disintegrated when exposed to the atmosphere. It was about seven feet in length and over a foot in diameter in the thickest portion. The tooth weighs two pounds, twelve ounces. Numerous other relics of pre-historic animals have also been found near Sweetwater."

Both the tooth and tusk are those of a mammoth—not a mastodon. Not only are they those of the largest of the several races of mammoths, but of all that group of elephant like animals, living and extinct, known as the *Proboscidea*. They are doubtless the remains of Archidiskodon, the great Imperial Mammoth. This giant beast stood from 13½ to 14 feet high. Thus he exceeded by 3½ to 4 feet the height of the ordinary circus elephant.

What then, are the characteristics of these fossils which make their identification so simple? Fortunately, the tooth is preserved, and of all the skeleton, this is the most valuable part for identification purposes. Once one has observed the marked contrast between the molar teeth of the mastodons and the mammoths, one will never confuse the two. While both animals bore strong superficial resemblance to our living elephants and to one another, on comparing them part for part, certain easily distinguishable differences become obvious at once.

The molar tooth of the mammoth is, or was, composed of a series of cusps. Literally, in fact, the word mastodon, means "nipple tooth." The molar of the mammoth is made up of a series of plates on edge, presenting the appearance of a series of low, parallel ridges.

A comparison of the body outlines of the two animals, part for part, reveals pronounced differences, particularly in the shape of the head and the thickness of the legs. The two animals are quite closely related, but the mastodon evolved first. Our living elephants belong with the mammoths.

Figurine of a mammoth found in Ice Age clay in Czecho-Slovakia

Courtesy of the American Museum of Natural History

The mastodon was a broader, bulkier and more thick-set animal than the mammoth. His legs were especially thick and his head was low

Professor Henry Fairfield Osborn, President of the American Museum of Natural History, a paleontologist who has been studying the evolutionary relationships of all the proboscideans for many years has recently reclassified their 290 or more known species, placing them in sixteen "races."

Professor Osborn's work was popularly summarized in the January February, 1925, issue of *Natural History* (published by the American Museum of Natural History, New York). He has placed the respective races of proboscideans on a sort of "family tree" which is reproduced on page 290.

Perhaps the first thing the readers will notice after a careful study of the peculiarities of each of the outlines, is the large variety of elephant like forms—in addition to the mastodon, the mammoth and the living elephant—that have existed during the geologic past and have become extinct. In general, the forms at the bottom of the diagram lived in the Eocene Epoch. This is the opening or dawn epoch of the Tertiary Period, or "Age of Mammals." Estimates of absolute geologic time vary, but a conservative estimate for the opening of the Tertiary Period is four million years ago. Compared with the total duration of the evolution of life on earth, even this is only the last 4 percent of it. In the Eocene Epoch, when the ancestors of the elephant and his relatives were in their early evolution man's ancestor is believed to have been a small ape, but since the majority of the races of proboscideans shown on Prof. Osborn's diagram did not become extinct until the Pleistocene Epoch, or Ice Age, which ended roughly 20 000 years ago some of these beasts although now extinct were contemporaneous, at least in continental Europe, with the men of the Old Stone Age.

Courtesy of the American Museum of Natural History

Contrast the profile of the mammoth's head with that of the mastodon shown in the lower left-hand illustration on this page

The proboscideans underwent their early evolution in Africa, but many of their races ultimately reached America by way of a land bridge which existed across the present shallow Behring Straits. Says Prof. Osborn "An insatiable wanderlust has always possessed the souls of elephants. They have gone to the very ends of the earth and have far surpassed man in adapting their clothing and teeth to all possible conditions of life." Thus 10 of the 16 elephant like races reached America.

Moeritherium is the most primitive form on the diagram. Its fossils were found in Northeastern Africa. It has no indication of a trunk, but its second incisor teeth are already enlarging. This foreshadows the future tusks of its descendents. It was only a little over two feet high. It lived in the Eocene Epoch.

Courtesy of the American Museum of Natural History

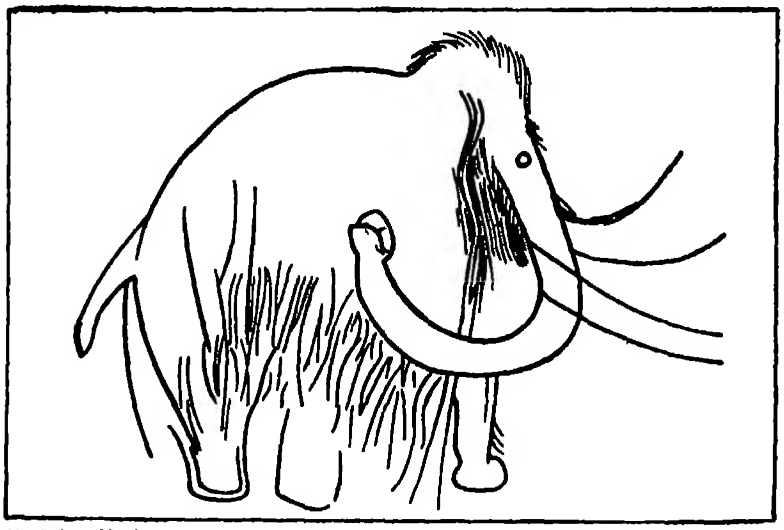
Moeritherium was the oldest, most primitive and smallest of the proboscideans known. The tusks and the trunk were beginning to evolve

Palæomastodon was ancestral to both the ordinary American mastodon and the races of mammoths. It lived early in the Tertiary Period. Its fossils have been found in Egypt. Of the interesting long jawed forms of mastodons shown on the lower right

hand part of the diagram, little can be said here Some of them had four tusks *Trilophodon* for example, used its shovel-shaped lower tusks for uprooting plants, and its upper tusks for defense Its jaw as long as 6 feet 7 inches touched the ground It spread through India and reached America before the Ice Age—its fossils having been found in the Dakotas Nebraska and Colorado Nearly 1 000 000 years ago, it became extinct. *Stegomastodon* fossils have been found in Arizona, Nebraska, Texas and Iowa. *Rhynchotherium* ("beak jawed) had down turned upper and lower tusks. It became extinct about 500,000 years ago It *has been found in fossil form in* Oregon, Montana, Colorado, California and Mexico

Returning to the main part of Prof Osborn's diagram or tree of descent, was more exclusively a forest-dwelling animal than the mammoths. Its food was twigs, *for whose mastication its teeth were well* adapted Its remains have been found in bogs in New York, Indiana, Ohio, Illinois, Michigan and Iowa, where it is said that "every bog contains a mastodon" They have also been found in Florida

The mastodon wore his hair long—an adaptation to the cold climate in which he lived Some of this long, coarse hair has been found in a swamp in New York State It must be remembered that during the Ice Age, even our central states were as close to the ice cap as Labrador is now The ice *covered most of the states mentioned above,* but as it melted back, the succeeding generations of mastodons followed it. Many died and were covered and preserved for us to uncover several thousands of years later



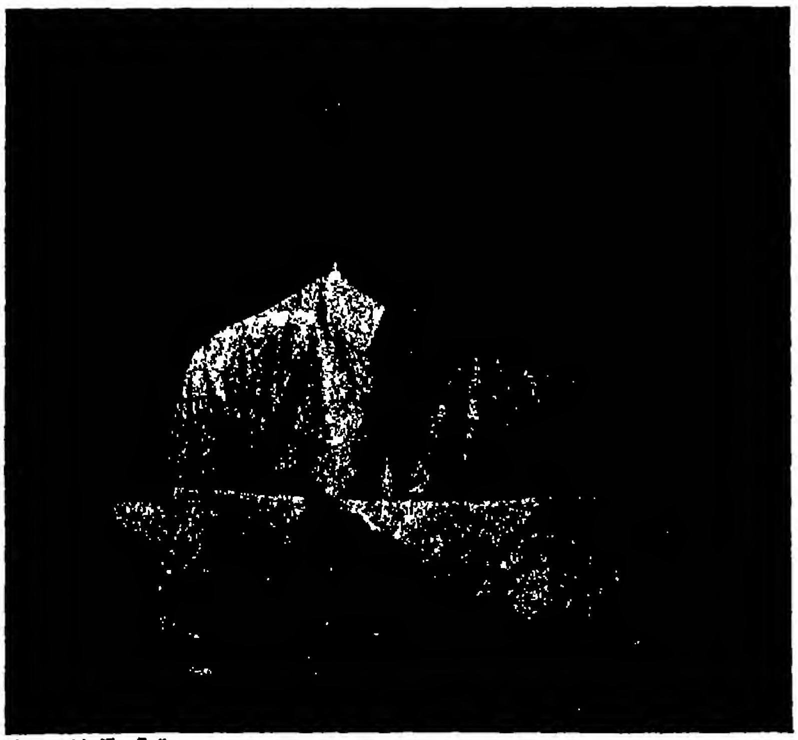
After Capitan and Breuil

An engraving of the woolly mammoth carved on the wall of a French cave by a Cro-Magnon artist, 20,000 or more years ago

Dinotherium had unique tusks which turned down, and were on the lower jaw It reached India, but not America, and became extinct about half a million years ago Note its great comparative height.

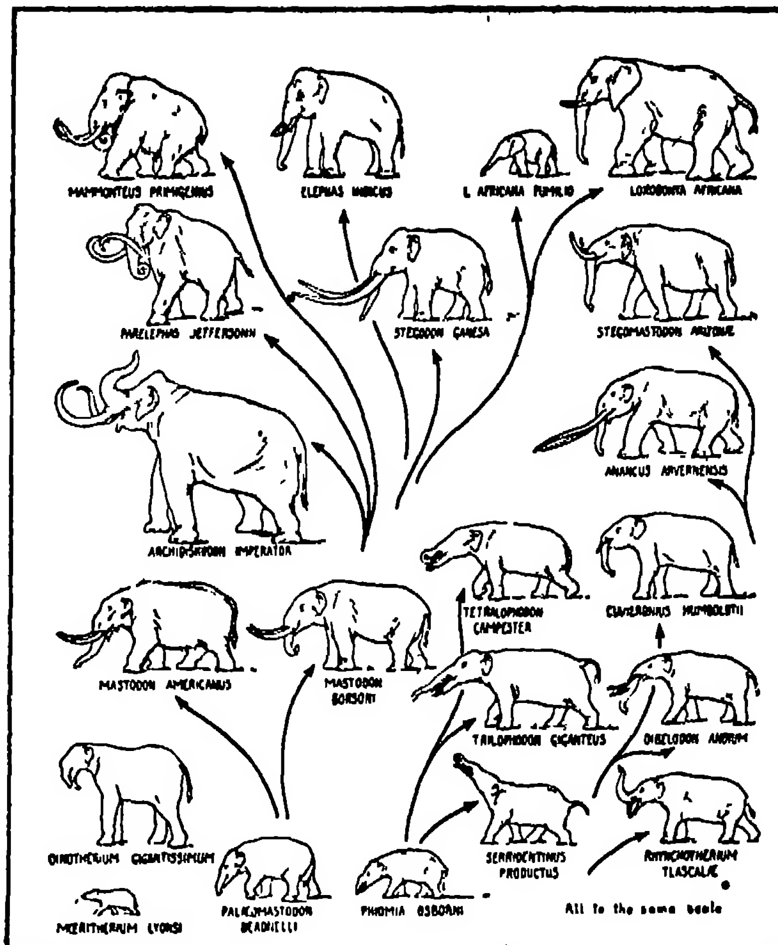
Mastodon americanus is the form which is commonly meant in this country by the word "mastodon" It lived well into the Ice Age, ranging from Europe across Asia to Alaska and throughout the United States. It was 7 to 9 feet high and was particularly stocky and robust, with thick leg bones. It

Archidiskodon imperator, popularly called the imperial mammoth, was the greatest of all the proboscideans. His fossils have been found in Nebraska, Kansas, Iowa, Texas, California and Mexico. The Sweetwater, Texas, fossils referred to at the beginning of this sketch belonged to *Archidiskodon.* His height was 13½ to 14 feet. Probably, says Prof Osborn, he was a tree-and-shrub browser, and when the forests that covered large parts of the west disappeared, due to



Photograph by [illegible]

Tooth and tusk of the imperial mammoth, greatest of the elephants. This specimen was discovered near Sweetwater, Texas



Courtesy of the American Philosophical Society

Osborn's new theory of the relationship and lines of descent of the races of elephant-like animals, living and extinct. Begin at the bottom

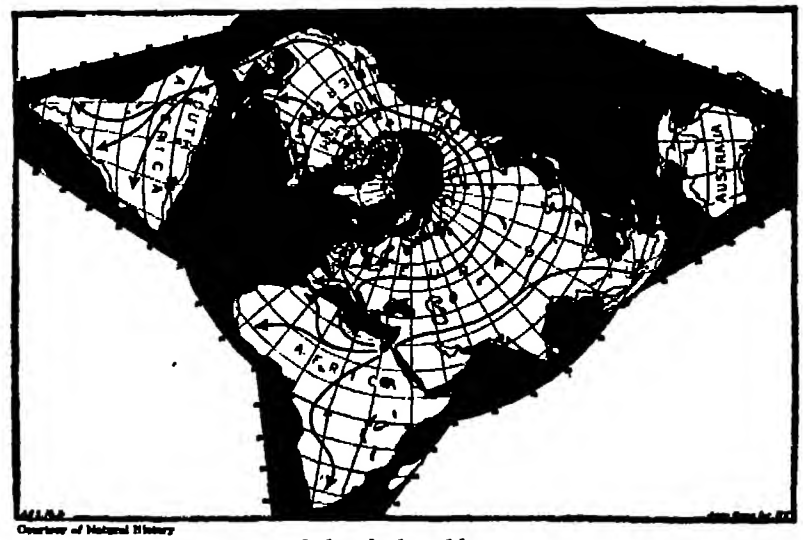
the melting back of the ice cap to the north, they too disappeared, becoming extinct. Probably he was nearly hairless.

By far, the best-known of the races of proboscideans was the Jeffersonian mammoth (see diagram, *Parelephas jeffersonii*) and the "woolly" mammoth (*Mammonteus primigenius*) The former was large, standing 10½ feet high, the latter was little over 9 feet high and was very shaggy, its hair being 18 inches long, with dense, shorter wool beneath. The remains of both of these *races have been found from Northern Europe* and Asia to North America Both races were marked by the extreme acuteness of the apex of the skull and by the strong incurvature of the tusks, which completely crossed each other in old age. (In the illustrations, contrast both head and tusks with the corresponding features of the mastodon.)

So plentiful are the remains of the mammoth that their tusks are used as an article of commerce today—a large part of the ivory we see being fossil ivory, probably ten or more thousand years old In Siberia, many of their actual carcasses have been found, still frozen in the ice which has preserved them "No other fossil type has left such remarkably complete data as the Siberian mammoth," says Herbert Lang, Assistant Curator of African Mammals, American Museum of Natural History, writing in a pamphlet entitled, "Problems and Facts about Frozen Siberian Mammoths and their Ivory"

The Cro-Magnon men who dwelt in France after the close of the Ice Age have left us rock etchings of mammoths which they hunted for meat. We also reproduce the photograph of a pre-historic figure of a mammoth. This was found in Czecho-Slovakia, among plentiful remains of charcoal fires and the debris of bones of hundreds of

(*Continued on page 292*)



Courtesy of Natural History

Theoretic migration routes of the elephant-like mammals from their center of dispersion in Africa, millions of years ago

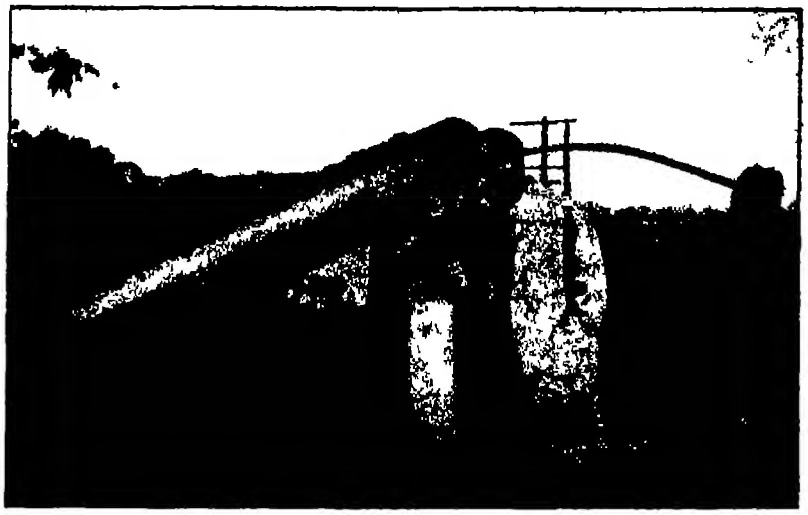
mammoths, killed and eaten 20,000 years ago, by the Old Stone Age hunters.

Gradually the mammoths dwindled in number until they became extinct. Today there are only two races of proboscideans, the African elephant whose true name is "loxodont," and the true elephants of India, Ceylon and Burma.

* * *

Another Amateur's Telescope

ONE of the most interesting reflecting telescopes thus far completed as a result of the telescope campaign which the Scientific American is conducting is that of F M Hicks, 1315 Oakland Avenue, Pasadena, California Two photographs of this instrument are reproduced on this page



Mr. Hicks at the eyepiece of his reflecting telescope, which is permanently mounted in an enclosure on the roof of his California home

Mr Hicks made the entire mounting, but purchased the paraboloidal mirror This has a diameter of 8½ inches and a focal length of five feet The outside tube is 10⅝ inches in diameter The 60-inch focal length is divided as follows mirror to the 2¾ inch diagonal, 42 inches, diagonal to 1½-inch prism, 11¾ inches, prism to eyepiece, 6¼ inches. Thus it is seen that the mounting is of the stationary eyepiece type described in Amateur Telescope Making" (Scientific American Publishing Company, 1926) page 31

In the polar axis, writes Mr Hicks, there is a Ford roller bearing hub which, with careful balancing of the tube, permits a delicate manipulation of the 90 pounds of tube and counterweight "Anyone who appreciates the convenience and comfort of a stationary eyepiece," he emphasizes, "will never regret going to the extra expense and work required to build such an instrument"

The declination axis was constructed from a Crane and Company, 2½ inch "T" of cast iron, this being thick enough to permit boring out true and turning in a lathe where necessary Into this "T," a Shelby tube, one-half inch thick, was inserted This holds the prism and carries the cast iron cradle to which the large telescope tube is bolted

The polar axis was constructed of two pieces of brass tubing brazed together at an angle suitable for this latitude A Ford roller bearing hub, turned down to suit, was placed in the polar axis tube, where it provides the rotary motion of the polar axis.

* * *

Color Changing Paints Show Temperature Changes

CHAMELEON-LIKE paints that change color when heated, only to return to their original color when cooled again are the interesting products described by W S Andrews, of the General Electric Company's engineering laboratory in Schenectady, New York.

"Such paints are made either of the double iodide of copper and mercury, or the double iodide of silver and mercury," says Mr Andrews. The former is bright red at ordinary temperatures, but when heated to about 160 degrees, Fahrenheit, changes to a dark chocolate brown which becomes black at boiling temperatures. As soon as it is cooled, it becomes red again. The silver and mercury salt is ordinarily yellow, and becomes a dark orange or brick red at 160 degrees.

Among the uses suggested for these paints by Mr Andrews are for the casings of bearings and other parts of machinery which are apt to become overheated, with disastrous effects, and for indicating the level of the liquid in a hot water tank. In the latter case, a vertical stripe is painted on the outside of the tank, and the height of the part where the color has changed indicates the water level —*Science Service.*

A Twelve-inch Reflecting Telescope

MR. JOHN RONEY, 617 West Jefferson Street, Louisville, Kentucky, writes as follows "In appreciation of your efforts to stimulate an interest in astronomy, I am sending you a picture of my 12-inch reflector, made at home during spare time I mounted my mirror on two Ford axles. I find this an excellent way of mounting a telescope. It seems, in fact, that the axles were made for this purpose.

"My mirror gives excellent results under good seeing, and magnifications as high as 400 are employed. I polished and figured

The two axes, setting circles, worms, eyepiece and bottom of the main tube of Mr. Hicks' telescope

nearly nine months before I got the surface of my speculum as I wanted it. The focal length is 78 inches. The disk is one and one half inches thick.

"The tube is built up of soft or machine steel, one inch by one-eighth of an inch in cross-section. This can be bought of any iron dealer in lengths up to 12 feet long My tube cost just two dollars. These strips are bolted to hoops of the same material with one-quarter inch stove bolts. The hoops are one inch greater in diameter than the mirror The tube is perfectly rigid, owing to the diagonal stays. My entire instrument was made at home, except for welding a "T" on the declination axis.

(*Continued on page 294*)

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"Since boyhood I have been deeply interested in astronomy and wanted a telescope, but was unable to pay the price of a first-class instrument. My first efforts were spent trying to make a four-inch refractor, but later I was willing to compromise with a reflector

Mr. John Roney's ingenious telescope, with fabricated tube

"Those for whom the starry heavens have never held any fascination, can never know the delight of the observer when he first directs his telescope which he has made with his own hands, upon the sky at night To me, the beauty and wonders of the sky surpass the beauty of our own planet to the extent that the latter becomes of little interest. I am waiting in wild anticipation for the pictures of other makers and their telescopes."

* * *

What Is a "Beginner"?

APPEARANCES indicate that at about the time of the famous "monkey trial" in Tennessee last year, nearly everyone who had an interest in evolution sat down and wrote a popular book about that subject. This took several weeks, and the publication of these books took several weeks or months more. The result was, that by the time these books were ready for distribution the subject of evolution was comparatively dead, for the largest part of the temporary interest in it had been created over night by the newspapers, and the newspapers know when the psychological time has come to drop a subject from front page scareheads to an inconspicuous stickfull on page seven or nine Consequently, it has been said that quite a few book publishers were caught "holding the bag" Few of these books, manufactured over night for a sudden demand, were notable anyway

However, Professor Graham Kerr of the University of Glasgow has now written an unusually brilliant book on evolution ("Evolution," The Macmillan Company, New York, 1926.) Instead of making a mere catalog of points in favor of evolution and attempting to meet the stock arguments against it, he has written to make his readers *think* His style is smooth and eminently readable and his publishers have produced an attractive book

Professor Kerr is not a mere "armchair" or laboratory student of evolution He has spent a large part of his life in the tropics studying the ways of animals and plants. In the tropics, he points out, the struggle for existence is most bitter, but comparatively few students of evolution have had the opportunity to witness it there.

In view of the laudatory statements we have made concerning Professor Kerr's book it is necessary to add that in our opinion it is not, as its author states in the very first words of his preface, "a book for the beginner." Professor Kerr uses terms which few beginners would understand, and fails to explain them when first he employs them. In fact, in most cases, he does not explain them at all Here is a partial list culled from a reading of the book under review. The "beginner" should know not merely their dictionary definition, but their biological significance:

pterodactyl
annelid
arthropod
ontogenetic
parthenogenetic
flagellata
cytoplasm
tetrapod
trypanosome
ungulate
ganoid
notochord
amphisbaenids

"This is a book for the beginner," says Professor Kerr Evidently, then, if the average intelligent reader can interpret this kind of language he is a beginner But if he cannot, what is he then? Is this a fair intelligence test?

We disagree with Professor Kerr. His book is admirably suited to the reader who has previously covered a textbook on zoology

* * *

The New Books

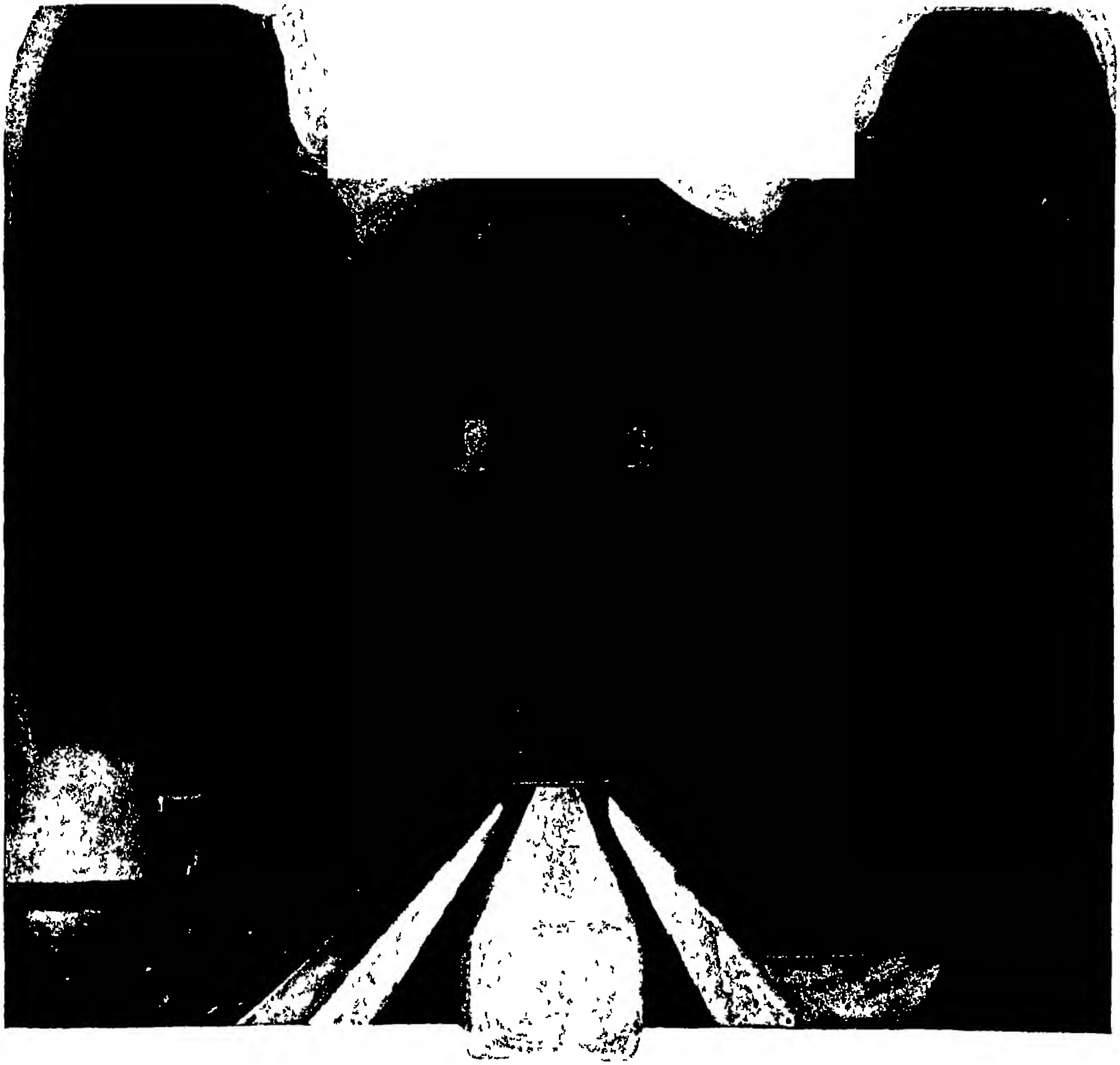
"MATTER, MAN AND MIND" (The Macmillan Company, New York, 1926), by W F F Shearcroft is a collection of essays on science, having a rather philosophical flavor In the preface the writer confesses to an insatiable curiosity regarding things scientific, and this has evidently resulted in providing him with a splendid background from which to write a book for other people who have an insatiable curiosity concerning scientific things. Some of the subjects are geology, the atom, relativity, evolution, life, heredity, chemistry and psychology Few writers of science can spread over as diverse a territory as this and retain authenticity This the writer has accomplished It is not a "fact" book so much as a "thought" book. The style is pleasant and smooth and the type of subjects is aptly suited to the readers of the Scientific American

Mr. Norvell's reflecting telescope

An Interesting Ten-inch Telescope

MR. G W NORVELL, of Covesville, Virginia, has completed a ten-inch reflecting telescope, a photograph of which is reproduced on this page. Mr Norvell writes: "My ten-inch reflector was built with the help of the book, 'Amateur Telescope Mak-

(*Continued on page 296*)



ing,' published by the Scientific American. I had this telescope under way when the book appeared, but the book showed me how to correct my mirror, which I had deeply hyperbolized After studying this book, and making two or three laps I landed a good correction. I am now enjoying looking at the belts of Jupiter I can see two large belts, and sometimes three or four lines as well as other markings show up. Saturn's rings look good, also. In other words, this reflector is doing fine work.

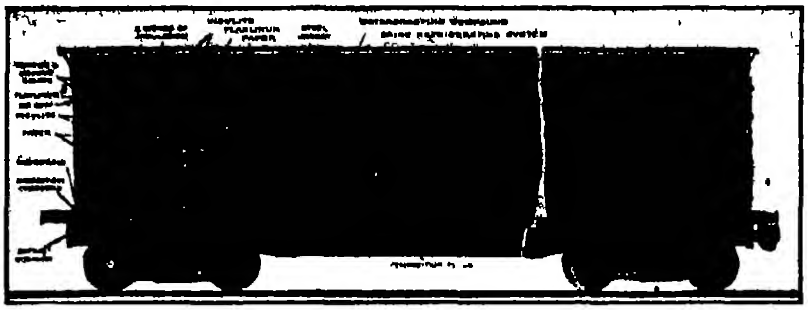
"I had great trouble," Mr Norvell continues, "for a long time previous to the publication of your book, because I did not then understand the knife-edge test. I was testing just inside the focus all the time, obtaining a shadow with a straight, vertical edge. Now that I understand this test I can tell if there is a surface as small as a pin head wrong with my mirror I used a disk one and one-half inches thick, and took my time while I was working it."

* * *

Shipping Milk 1,800 Miles to Market

A FINE achievement of unusual note was the *transportation of milk, in perfect condition*, from point of shipment to point of unloading, over a distance of 1,800 miles, from Marshfield, Wisconsin, to Miami, Florida.

In Florida, the milk problem has been a vitally real one. *Cows do not thrive there.* Fresh milk is costly—35 cents a quart. The supply is limited.



The insulated car containing a refrigerating system and a large glass-lined tank in which milk was shipped safely 1,800 miles

At Marshfield, Wisconsin a glass-lined milk tank-car was loaded with tuberculin-tested milk Dr Franklin Leiter, City Physician of Marshfield, inspected the content and equipment of the car *It contained six* thousand gallons of milk, 40 ten-gallon cans of 40 percent cream The content was cooled to 35 degrees, the car was locked and sealed, and with the temperature outdoors at 26 degrees, it was sent on its way *from Marshfield at* 1 P M., Tuesday, February 16, 1926

The car reached Miami, Florida, four days and five hours later Its contents are said to have arrived in perfect condition, the temperature of the milk being 36 degrees, *with an outdoor temperature of* 92 *degrees.* The milk was shipped 1,800 miles with an outside temperature change of 66 degrees Under these conditions the temperature of the contents remained within only one degree of its original

What the effect of this unusual trial test on the future of milk shipment will be, it is hard to predict. If it proves practicable, and economical, to ship milk over distances as great as 1,800 miles, a great shift in American dairying industry may take place Almost certain it is that the old fashioned method of shipping milk in cans that is, in broken bulk, is inefficient and costly

* * *

Gold in Sea Water Not Paying Quantity

THERE is gold in sea water but it will never make anyone rich Professor Fritz Haber, the German chemist famous for his researches on this subject and also for his contributions to agriculture in making possible the capture of nitrates out of the thin air, warns possible investors against plausible schemes for boiling the wealth of Crœsus out of the ocean. It can not be done, he says.

Gold in exceedingly minute quantities is found everywhere in the oceans of the world, but curiously enough the water and the floating ice near the north pole assay about four times as much as water from the warmer portions of the globe. The average concentration of the precious metal in the 5,000 samples analyzed by Dr Haber is only about one one-hundredth of a milligram, or three one-millionths of an ounce, to the ton; so that he has characterized an attempt to recover paying quantities of gold from the sea as "a search for a very small and doubtful needle in a very large haystack."—*Science Service.*

* * *

A New Ceramic

THROUGH the introduction of precision methods which start with the raw material itself and follow through to the finished product, there has been evolved a new ceramic.

Isolantite, as the new material is called, goes back to the days of the World War, when the French air service, hard pressed for suitable spark plugs to take the place of former German products, became involved in the major problem of finding an insulating material for spark plug cores. The gruelling conditions of aviation engine service called for something far better than standard spark plugs.

After several years of research, the French technicians were rewarded with a new ceramic possessing many characteristics heretofore associated only with other materials.

Whatever machining or cutting must be done to a piece of this new ceramic must be *done prior to firing* Once fired, it is so hard that it defies the hardest steels.

The fine powder of which this material is made is poured into a mold, and the mold is set in a powerful hydraulic press If an intense pressure is applied, say 25 tons to the square inch, the powder still remains a powder, because the minute particles have failed to adhere. This is because there is nothing "fatty" or moist to bind the particles into a solid mass. However, in the presence of a gas catalyst, which is passed through the loose powder just prior to compression, the powder particles stick together to form a solid mass. Under high pressures applied by hydraulic presses, it is possible to mold pieces and to form round or square rods of uniform density for subsequent machining. Rods as small as 1/16 inch diameter and as large as 10 inches in diameter, may be formed in this manner Also tubes 1/16 inch up, with pin-holes up to holes almost as large as the external diameter, may be formed by extrusion presses.

The molded rods and blocks are now cut into lengths or slabs of the desired size or thickness, in automatic cutting machines and gang cutters, which cut to size and trim the ends straight and smooth.

The pieces and slabs are next passed through the various machining processes. *Thus the round rods may be formed into* shells or posts in much the same manner as a piece of brass or steel rod is turned in a lathe. The rod is placed in the chuck of a high-speed lathe and a cutting tool brought in contact with the exposed end. Toler-

(Continued on page 298)

Everything that is possible with brass can be duplicated, it is claimed, in isolantite, even to the cutting of accurate threads

ances of hundredths of an inch are met in the ordinary routine work, while precise tolerances of thousands of an inch are met by lapping and grinding as in standard machine practice.

The new ceramic is drilled in the same manner as metal. Standard twist drills are employed. Gang drills are used for drilling grouped holes. It may be tapped for male and female threads, in the standard manner. The threads are clean cut and strong. An iron screw placed in the threading will actually be stripped of its threads before the fired ceramic will give way, according to statements issued.

The raw or soft product is now ready for firing. This converts it from a workable material to a rock-like product. The pieces are placed in carborundum trays and heated to 2700 degrees, Fahrenheit. They are held there for 60 seconds, during which time the heretofore soft material suddenly becomes harder than agate, as strong, it is claimed, as cast iron and tough.

The new product has found application in radio reception and transmission, where insulation requirements are most critical. Phase difference angle or power factor is the best basis for determining the quality of an insulating material in radio frequency applications, and this material, it is stated, shows a phase difference of but six minutes, or 1/10 degree at most, and 1/100 degree under certain conditions of test. This compares with 26 minutes for hard rubber, and 2.0 and 3.7 degrees, or higher, for other insulating materials that are widely employed in radio. The phase difference represents power loss or dielectric absorption.

The dielectric constant of isolantite is 3.6 at low frequency, and correspondingly less at higher frequencies, as compared with the value of unity for air. The lower the dielectric constant the more desirable is the material for radio purposes.

Still another factor in considering insulating materials for radio applications and in delicate electrical work is resistivity. The volume resistivity of the product under discussion at 50 percent relative humidity is 600,000,000,000,000 ohms per cubic centimeter of volume, and 5,000,000,000,000,000 ohms per square centimeter of surface. It has a break-down resistance of over 30,000 volts per millimeter of thickness, stated to be in excess of any commercial material now available. It retains its insulating and other electrical characteristics at glowing temperatures.

Pieces and tubes, made by the extrusion method, have a wide chemical application, as they are non-porous and will not absorb liquids with which they come in constant contact.

* * *

Skull Operations Fail as Crime Cure

Operations on the skull to remove the cause of crime are unwarranted medical practice, in the opinion of Dr. Shepherd I. Franz, psychologist in the University of California, and expert in the re-education of the damaged brain.

The supposition that a bony protuberance of the cranium or some malformation due to accident may press on the brain and be the specific cause of wrong-doing is rejected by Dr. Franz and relegated to the limbo of phrenology or like pseudo-science. Surgeons of questionable ethical standards, with pros-

Ceramic rods and tubes formed by extrusion presses. Rods and tubes are made from 1/16 of an inch up to several inches in diameter

pects of a high fee, have been willing to operate on a criminal, the purpose in part being to influence a trial court in the direction of leniency. In some cases of this sort, the patient, profoundly influenced by so serious an operation on himself, has actually been led to believe that the treatment has cured him. Thus purely by suggestion he deserts the criminal life. To this extent only is the cranial operation of any value.

Extended experiments in brain operation have convinced Dr Franz that the upper brain structure works generally as a whole, and not in specialized departments. Damage or pressure on one spot does not throw any one faculty alone out of commission, nor does any single faculty or sense belong solely to one unique location. Removal or destruction of a small special brain area will seriously upset the entire mental function, but the patient can be re-educated to perform all his duties with other cerebral material. Upon this assumption immorality or crime tendency is likely to be a feature of the entire cerebrum, and not amenable to surgical operation.—*Science Service*

• • •

Shall We Sterilise Our Mental Defectives?

CONTRARY to a rather widespread belief, even the complete sterilization of all our mental defectives would not be successful in ridding the world of feeble-mindedness for more than a single generation. This is the conclusion reached by *The Lancet*, foremost medical and surgical journal of Great Britain, in an editorial.

If these facts be so, then the much-advocated plan of some social reformers would come virtually to nought, for about seven percent of us are unsuspected "carriers" of feeble-mindedness, in whose children or grandchildren the latent quality would reappear Thus the work would have to be done all over again.

According to the principles of heredity, first worked out by Mendel, the priest whose noted experiments with sweet peas put the science of genetics on a relatively mathematical basis, the mating of two apparently normal carriers will give one defective child in four, and half the children will again be carriers. There is no known way to ascertain which of us is an unsuspected carrier of feeble-mindedness

Professor R C. Plunkett calculated that it would take about 8,000 years to reduce the percentage of feeble-minded in the population from the present three-tenths of one percent to one in one hundred thousand, by segregating or sterilizing those who are themselves actually feeble-minded.

• • •

Why the Oriental Needs Less Food

THAT the Chinese and Japanese can live longer, work longer or starve longer on a low ration of food than the American or European peoples is an ancient belief Why these Orientals are able to live on so little food has only recently been worked out scientifically Their basal metabolism, or energy exchange of the body, is lower They are fundamentally more efficient engines than we are, and their noted ability to live on a scant diet is seen to be not wholly due to their lack of wastefulness or to some special psychological characteristic, such as "natural toughness," which many have ascribed to them.

If one of two otherwise identical steam engines gives a greater relative output of power than the other, we say that its coefficient of efficiency is higher Evidently, if the tests carried out by Grace MacLeod of the Department of Nutrition, Teacher's College, Columbia University, Elizabeth E. Crofts of the Department of Physiology, Mount Holyoke College and Francis G Benedict of the Nutrition Laboratory of the Carnegie Institution of Washington, tell us the true state of affairs, the basal metabolism of the Chinese and Japanese is perceptibly lower than that of Occidental peoples.

On several previous occasions, research has

been done on this problem but the results obtained have been open to the contention that the climate, the diet, and particularly, the nervous and muscular tension incidental to life in general, are of an altogether different order among the Orientals than among those living in the rush of Western civilization. The influence of the tropics upon metabolism has never been entirely clear.

It seemed desirable therefore, say the authors of the report (published in the *Proceedings of the National Academy of Science*), to study the metabolism of a group of Orientals transplanted to an American environment, so that the only variable factor would be that of race. Consequently, these investigators studied the basal metabolism of seven Chinese and two Japanese women.

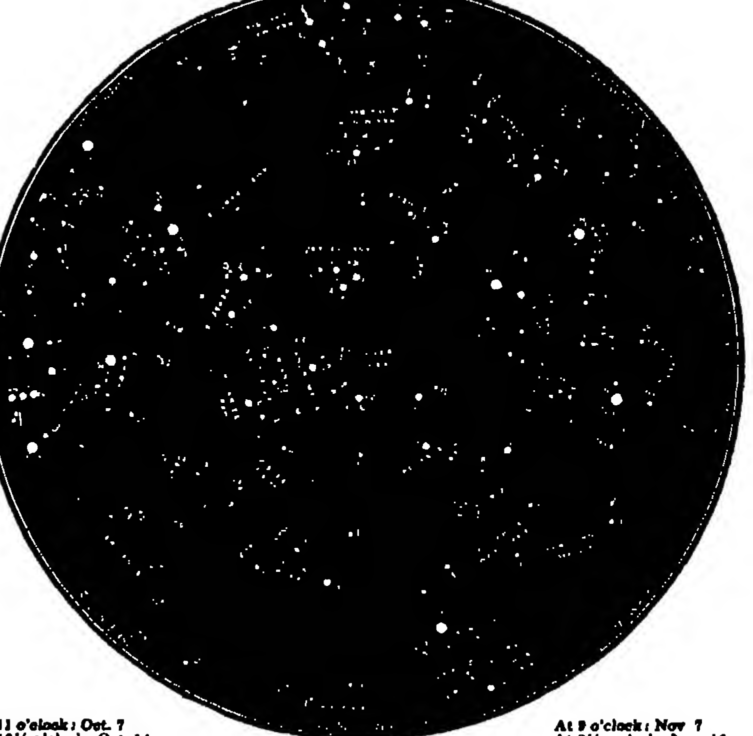
The findings are summarized as follows. The vital capacity was, judged by American standards, very low, that is, 14.3 cubic centimeters per centimeter of height and 1.54 liters per square meter of surface area, as compared with the normal standards for women of not far from 20 cubic centimeters and 2 liters, respectively. The blood pressure of the three subjects measured was normal. The average pulse-rate for the entire group was 60 beats per minute, with a minimum of 54 and a maximum of 64, that is, values that are at the lower, if not indeed slightly below the lower, limits for normal American women.

The most significant findings had to deal with the basal metabolism, which in all cases was below the accepted normal and in most cases strikingly low, the average metabolism being 10.4 percent below the Harris and Benedict prediction standards for women.

Commenting on these findings, the *Journal of the American Medical Association* says: "Has the rush of Western civilization produced a higher metabolic rate? Is the low metabolic rate of the Chinese a physiologic expression of their more philosophic outlook on life?"

The Heavens in October

By Professor Henry Norris Russell, Ph.D.



At 11 o'clock: Oct. 7
At 10½ o'clock: Oct. 14
At 10 o'clock: Oct. 22
At 9½ o'clock: October 30
At 9 o'clock: Nov. 7
At 8½ o'clock: Nov. 14
At 8 o'clock: Nov. 22

The hours given are in Standard Time

NIGHT SKY: OCTOBER AND NOVEMBER

The Heavens

ON our star map this month the starry heavens show the great square of Pegasus high in the south. Below it is the great dull region occupied by Aquarius, Cetus and Eridanus. To the west are Cygnus, Lyra and Aquila, in the northwest Draco—due north, the Great Bear low down, then the Little Bear, with Cepheus and Cassiopeia still higher. Andromeda, Perseus and Auriga are in the northeast, and Aries and Taurus in the east, with Orion rising.

The Planets

Mercury is an evening star throughout October but, being south of the sun, is not well placed. At the end of the month he sets about 5:45 P.M. and may be seen low in the twilight. Venus is a morning star, rising about 5:30 A.M. in the middle of the month.

Mars is in Aries, and is becoming very conspicuous as he approaches opposition. On the 1st he rises at 7:40 P.M. while on the 31st he comes into sight at 5:10, and is visible all night. He is as bright as Sirius at the beginning of the month, and much brighter at its close. His approach to the earth appears on the 27th when he is 42,600,000 miles away. Although not quite so near as at this last opposition, he is so much farther north that he is quite as well observable, and important results may be anticipated from the observations of this month and the next.

Jupiter is in Capricornus and comes to the meridian about 8 P.M. in the middle of the month. Saturn is an evening star in Libra, too low to be easily seen. Uranus is in Pisces, observable in the evening, and Neptune in Leo, visible only in the morning hours.

The moon is new at 5 P.M. on the 6th, in her first quarter at 9 A.M. on the 14th, full just after midnight on the 21st and in her last quarter at 6 A.M. on the 28th. She is nearest the earth on the 19th, and farthest away on the 3rd and again on the 31st.

During the month she passes through conjunction with Neptune on the 2nd, Venus on the 5th, Mercury on the 7th, Saturn on the 10th, Jupiter on the 16th, Uranus on the 18th, Mars on the 22nd, and Neptune again on the 30th.

Learning to Use Our Wings

Aircraft are being put to use in peace as well as in war. This department will keep our readers informed of the latest facts about airships and airplanes

Conducted by Alexander Klemin

In charge, Daniel Guggenheim School of Aeronautics, New York University

The *Airster*

PROGRESS in aviation does not always mean novelties or radical departures from standard practice. It is just as important to combine the elements of excellency already known into a harmonious design which can be sold at a moderate price to the public. It is gratifying to know that, besides the usual construction for government purposes, a number of aircraft firms are selling to private operators in quantities. One firm has a production of one airplane a day and announces in typical automobile style that orders must be given several months in advance because sales surpass production!

One of the best of these general utility airplanes is the *Airster* built by the Buhl Verville Aircraft Company. Equipped with a Wright air-cooled 200 horsepower Whirlwind engine, the *Airster* can land at 45 miles an hour and develop a maximum speed of 120 miles an hour. Its weight empty is 1,550 pounds, fully loaded it weighs 2,550 pounds, and so it has a useful load of 1,000 pounds.

As a passenger airplane, it has comfortable accommodations for two passengers besides the pilot, with an allowance for about 85 pounds of baggage. The young lady in the photograph has easily climbed up a step to the wing, veneer covered to withstand hard usage, and is ready to enter the front cockpit without any great effort. The cockpit is comfortably upholstered and there is a large windshield to protect the occupants from the air blast. The airplane carries enough fuel for 3¼ hours flight at full power, and it can be readily converted into a mail plane with a carrying capacity of some 495 pounds of mail. Incidentally when the front cockpit is covered in for mail, the maximum speed goes up to 130 miles, sufficient to maintain schedules in the heaviest winds likely to be encountered in the United States.

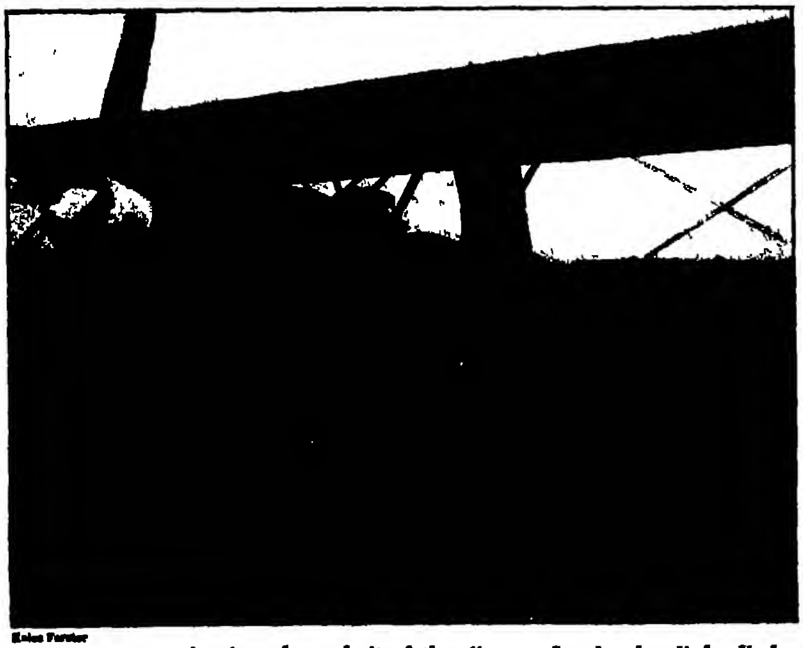
The front view of the airplane shows how simply the wings are braced, with streamlined metal tubing replacing the bulky wooden struts once customary, and but a few wires to give adequate bracing. The landing gear involves no wires at all, so that adjustment is reduced to a minimum. The shock absorbers are of the telescopic type with the rubber cords enclosed. The metal propeller looks delicate, but is amply strong and is far more efficient than the wooden propellers with their heavy blades. There is a good deal of engine exposed for air-cooling purposes. If hangar space is small, the loosening of a couple of pins allows the wings to be folded back. Well balanced and with plenty of wing area for its load, such an airplane is likely to give the general public something which is almost as useful as a first-class automobile.

Folding Wings

THE Fairchild three-seater cabin monoplane is of the same general utility type as the Buhl Verville *Airster* and similarly embodies the valuable feature of folding wings. Our photograph shows the wings folded back, reducing the overall width of the airplane from 44 feet to 12⅔ feet, so that it can be housed in an ordinary garage. While the details of the wing mechanism are not yet available for publication, our imagination will readily show how, by releasing a pin at the point where the front spar of the wing attaches to the fuselage, the wings can be swung about the rear spar connection to the body as a pivot and in a few seconds the plane made to assume its folded proportions. It is not inconceivable that airplanes may soon be seen traveling the public highways, thus arranged making their way from the garage to the flying field.

Air Sleepers

A RECENT announcement in the *New York Times* states that Fokker, now permanently located in the United States, is building a thirty five passenger air sleeper to be used in transcontinental service between New York and San Francisco. The airplane is to carry the business man across the continent in something less than thirty hours, flying night and day, and at least three motors are to be employed in the power plant. The fuselage of the airplane is to be built in two sections. The upper section is to be made over into sleeping berths at night, similar to the berths now used by the Pullman Company. The lower section is to be provided with parlor car equipment.



Keine Fender

A passenger stepping into the cockpit of the *Airster*. It takes but little climbing ability to get into a modern plane

Front view of the *Airster*. The modern airplane is "clean," with slender metal struts replacing bulky wooden ones, and with but few wires exposed

Fokker is a designer of such reputation and ability that any such announcement may be treated with respect At the same time it must be remembered that the provision of sleeper accommodations is a matter of great difficulty, if the dimensions of the fuselage are not to be increased beyond the point where its air resistance will seriously cut down the speed

"Transport Aviation," by Archibald Black, recently published by the Simmons-Boardman Publishing Company of New York, deals authoritatively with the matter of sleeper accommodation on board passenger air lines. The open cockpit of a military two-seater observation airplane, equipped with a 400 horsepower engine has a width of about 28 inches and a height not exceeding 3 feet When an airplane of similar power is used to transport some eight passengers in an enclosed cabin, with comfortable seats, a system of ventilation and heating and overhead lighting, it is necessary to provide a width of nearly 4 feet and a height of about 6 feet Mr Black has studied in some detail the conversion of such a passenger airplane into a sleeper He proposes the use of two compartments instead of the one passenger cabin, with toilets between the two To economize in space and to remove any objections to the use of the space as a passage at times each of the toilet facilities is to be arranged to swing out of the way into a covered position.

The upper berths are to be raised up to the ceiling when not in use, being carried by cables on spring-balanced rollers. The lower berth is to be permanently located and used as a seat during the day. This plan, however allows only four passengers to be carried, in spite of the relatively enormous fuselage It would appear that only in very large airplanes would there be sufficient room for sleepers, because the cubic capacity goes up as the cube of the linear dimensions, while the cross-sectional area and the air resistance go up as the square of the linear dimensions.

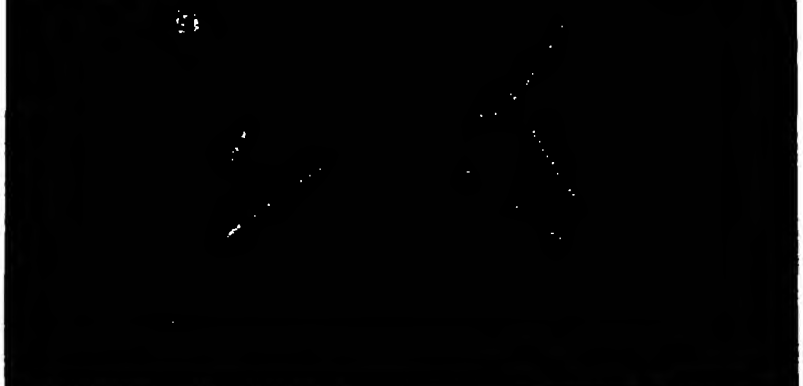
Incidentally, readers will find "Transport Aviation" an interesting text dealing with such topics as the scope and coordination of air transport, its general possibilities; costs, and technical problems of operation.

The Boerner Airship

We are now able to present some hitherto unpublished information regarding the proposed Boerner airship, which has been examined by and has met the approval of competent German authorities.

The outer form of the airship is streamlined longitudinally with a rounded bow and the tail brought to a point, a form which we have learned to associate with airships of all types. However, the cross-section of the airship is almost elliptical, with the underside offering a flat surface to the air Such a cross-section must inevitably increase the aerodynamic resistance, which is a disadvantage, but it is just as certain that such a cross-section will increase the dynamic effects in flight. When an airship is moving and has its longitudinal axis inclined to the flight path, then dynamic effects intervene—analogous to those which are entirely responsible for the sustaining of an airplane.

In the navigation of an airship this dy-



Herbert Photos
The Fairchild three-seater cabin monoplane showing its wings folded back

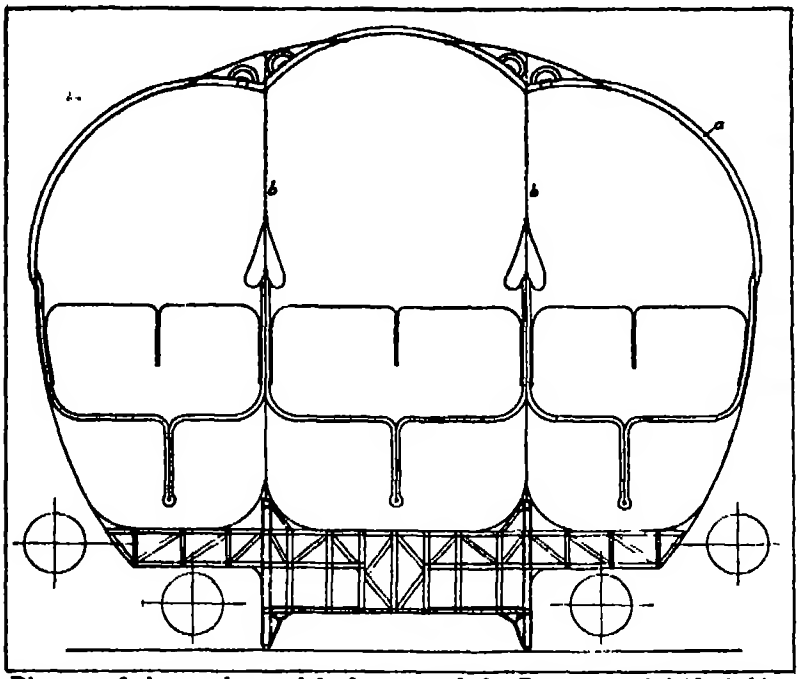


Diagram of the gas bag and keel system of the Boerner semi-rigid airship. The outer cover, a, is double and contains a protecting mantle of nitrogen under pressure. The two parts, b, divide the balloon lengthwise into three compartments and also constitute a flexible suspension permitting expansion of the gas. The ship has a rigid keel

namic effect can be made to counteract, to a certain extent, any loss of equilibrium between the weight of the airship and the buoyancy of the gas. If, for example, the action of the sun's rays causes the gas in the cells to expand, the airship rises. To prevent the rise, the navigator must either allow gas to escape or else he must depress the nose of the airship so that the dynamic force acts downward If on the other hand, the gas in the cells cools off (as it may do at night or when the airship is sheltered by clouds), and hence contracts, the navi gator must resist the tendency to drop by throwing out ballast or by raising the nose of the ship and securing an upward dynamic effect Valving gas, particularly helium, is expensive Also, valving and throwing out ballast are both undesirable because either will limit the possibility of further maneu vers. Therefore the possibly increased dy namic power of the Boerner design is advan tageous.

The diagram illustrates the gas-bag and keel system The airship is of the semi rigid type, with a rigid keel, built up of duralu min girders. These take care of the com pressive loads, while the fabric takes care of the tensile loads. With the rigid keel, only a slight degree of excess gas pressure should readily preserve the required form of the airship

The keel seems well arranged to provide ample cabin and engine space The outer cover "a" is double and contains a protect ing mantle of nitrogen under pressure The two parts "b" divide the balloon lengthwise into three compartments and also constitute a *flexible suspension permitting expansion* of the gas. Helium or hydrogen is con tained in the upper part of the bags, coal gas in the middle compartments, and air below. When the hydrogen or helium and the coal gas are expanded to their fullest extent, the air in the lower part of the airship is completely displaced. The Boer ner airship therefore embodies the equiva lent of air ballonets. Air scoops or fans are provided for filling the ballonets when this process is needed in maneuvering

Hydrogen is readily inflammable, but only when mixed with a certain proportion of air or oxygen. As long as the hydrogen in the gas cells is in a high state of purity it cannot ignite. But if it escapes through the fabric and then encounters an igniting cause, real danger arises. The suggestion has often been made that if a layer of nitrogen sep arated the inflammable gas from the atmos phere, the danger would be greatly mini mized. In the Boerner design such an outer layer of nitrogen under pressure is in the narrow space marked "a" in the diagram Of course the device involves a certain amount of weight in the extra fabric re quired, and there is some additional com plexity The inventor also claims, and quite justifiably, some additional protection against fire because of the fact that the engines and passenger compartments are separated from the gas cells by quite a height of interven ing air Experiments have shown the nitro gen to be quite an effective protection against fire, and it also provides a measure of thermal insulation which is valuable as well as some protection against diffusion, nitrogen being a sluggish, inert gas.

In the lower part of the great central keel, thirty to fifty tons of water are taken in automatically when the ship alights on the water There again we have an idea which is by no means absolutely novel, yet is worth thinking about The most plaus ible form of airship hangar, and one which the Germans have already employed, is a floating one which can be pointed into the wind If the keel can take on such a large weight of water, there will be no danger of rebound after alighting, nor much danger of sudden lateral movement The work of the landing crew will be greatly facilitated There may be some mechanical difficulty in pumping out the water when the ship is to rise, but nevertheless the plan has certain attractions. One in particular is that an ordinary water rudder could be used to steer the airship when water bound

One of the great difficulties in long range airship navigation is to compensate for the weight of fuel consumed As fuel is con sumed, the airship gets lighter and may rise to uncomfortable heights unless gas is valved freely A variety of solutions have been offered Thus in the United States an elaborate system of recovering water from the exhaust gases of the engine to act as compensating ballast has been entirely suc cessful It is complex however and the large amount of radiator area required means considerable reduction in speed

British engineers have approached the problem from a different point of view and have succeeded in burning hydrogen mixed with kerosene in their engines, compensation for the decreased weight of the kerosene is therefore followed automatically by the burning of hydrogen and a corresponding decrease in lift. In the Boerner airship the plan is to burn the coal gas (which, as we have seen, is used with hydrogen as the lifting medium) and thus compensate for the consumption of liquid fuel There is no reason why this should not be as effec tive as the burning of hydrogen. The draw-

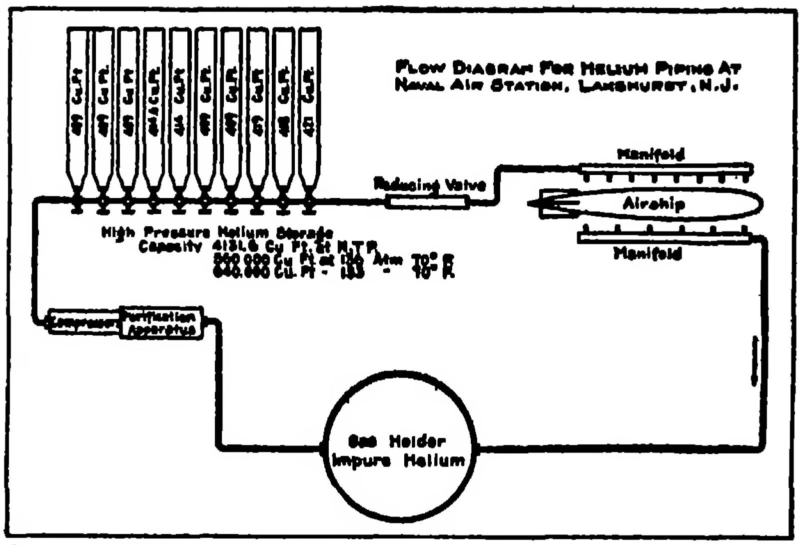


Diagram showing how helium is taken from an airship, stored, and then purified and led back to the airship when wanted

back is that coal gas, which is a mixture of hydrogen and methane, while considerably lighter than air, does not provide nearly as much lift as pure hydrogen We are inclined to think, therefore, that the use of coal gas as a lifting medium is a disadvantage in the proposed design if compared with a hydrogen airship There is thus to be said for the Boerner design however, that the coal gas could be used as a compensating fuel with helium as the main lifting element

The design provides for swivelling propellers, and there the engineers are on sound ground, if they can surmount mechanical difficulties Swivelling propellers in conjunction with the dynamic properties of the hull should render vertical maneuvering very simple

Whether a semi rigid design of this type can be realized in the huge sizes of the *Shenandoah* or *Los Angeles* remains to be seen It offers, however, a possibility of lighter structural weight and contains many valuable ideas.

Storing Hydrogen and Helium

A BOOK on Balloon and Airship Gases, by Chandler and Diehl, recently published by the Ronald Press of New York, contains a wealth of information on a subject which has hitherto only been covered in widely scattered articles and papers. It deals thoroughly with the production processes of hydrogen and helium, with special reference to their use in lighter-than-air craft, and covers many interesting and curious properties of these gases. With permission of the publishers, we cannot resist drawing on this text for a brief description of the little known methods employed for storing the somewhat dangerous hydrogen and the precious helium.

What is a "nurse" balloon? When hydrogen is produced intermittently and in large quantities by the silicon process, it is necessary for military purposes to be able to store it rapidly in a readily transportable form. This is accomplished by using large three-ply balloons of capacities up to 35,000 cubic feet somewhat similar in shape to the familiar city gasometers, but with sides like an accordion From these the hydrogen is drawn to the smaller captive balloons, and hence the term "nurse" balloons.

City gasometers are in the form of an inverted tank or bell dipping in water contained in an overground steel tank As the gas enters under the water, the bell rises, but the water always forms a perfect seal

Perhaps our readers have noticed the extraordinary number of rivets which the city gasometer is provided with The hydrogen gasometer has its rivets set even closer together, owing to the tenuity of the gas. Curiously enough when Ford's engineers set out to design their metal-clad airship, they went to the gasometer for lessons in making riveted seams tight enough to prevent leaks

The gas bell is convenient and efficient, but where the enormous volumes of gas required for such ships as the *Los Angeles* are to be handled, gas must be stored under pressure Besides the advantage of conserving space, the high pressure tanks (2,000 pounds per square inch pressure) also have the desirable characteristic of avoiding the solubility of the gas in the water of the bell, and of not needing the steam heat which alone keeps the water from freezing. There is a certain danger of explosion, but this is minimized by testing the high pressure tanks to values far above their working limit.

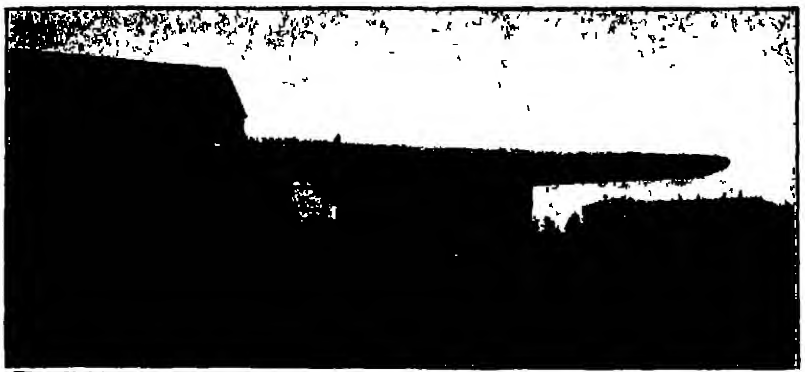
Perhaps the best example of high pressure tank storage is to be seen at Lakehurst The ten tanks are only 40 feet in length and 4 feet in diameter, but have a storage capacity of 640,000 cubic feet of gas after it has passed the reducing valve. The diagram shows the very neat manner in which gas passes from the airship to the impure helium holder, then to the purification apparatus, then to the pipes which connect the storage tanks to the reducing valve, and then back again to the airship.

With the aid of the tank cars specially designed for railway transportation of helium, and previously described in our columns, it may be said that the navy has worked out an almost perfect system of storing and delivering our valuable helium.

Miniature Aircraft Fliers

IN Europe in general, and in England in particular, far more attention is given to the training of aircraft mechanics than in the United States. An instance of this is the elaborate system of apprenticeship set up by the British Royal Aircraft factory for the training of expert airplane and airplane-engine mechanics. A group of these boys are shown in our photograph ready to start off their model aircraft at a meet recently held at the Halton airdrome in England. There is no doubt that, apart from the sporting interest of these models, there is a possibility that a great deal can be learned about aerodynamics and airplane construction by their use But, if this is to be true the models must be built with skill and accuracy

We have received a small loose-leaf handbook from Frank H Cheley, Denver, Colorado, entitled "Miniature Aircraft Fliers," which is both excellent and timely There is more to model construction than at first meets the eye. A flat piece of cardboard is not a wing, light straight-grained wood must be carefully chosen, and cut into spars, ribs, et cetera, with steamed tissue paper as a covering With the use of cardboard templates it is possible to reproduce the most carefully designed airfoil with accuracy Tail surfaces may be built in similar fashion to the wings and adjusted at any desired angle to the fuselage by rubber bands. For the fuselage and the motor base, hollow



The Fokker three-engined monoplane now in regular use between Philadelphia and Washington, D. C., for passenger carrying

bamboo forms an ideal structural material, although steel wire and hooks may be substituted

The handbook gives exact instructions on how to whittle a small block of wood into a propeller, and there can be no greater test of a whittler's skill Some skill also must be developed in winding flat rubber strands which serve as the source of motive power. It is possible to balance models very accurately to try the effect of various curvatures on the wing, various tail settings et cetera, all of which is most instructive Speeds of a mile a minute and glides of over a mile have been attained with small models.

A Regular Passenger Service

IN the past few years a number of attempts have been made to establish passenger-carrying air lines. While these were successful from an operating point of view, with but one or two accidents, they were unsuccessful from a financial point of view Every expedient to attract the traveling public was employed, yet failed to draw patrons in sufficient numbers. *It is* therefore very satisfactory to learn that a regular passenger service is again in being. This is the Philadelphia Rapid Transit Company's air line between Washington and Philadelphia

It may be that the holiday spirit and the presence of the Sesquicentennial Exhibition at Philadelphia may have something to do with the influx of flying passengers, but at any rate the service is booked several weeks in advance. The flying distance between Washington and Philadelphia is 125 miles, the flying time is one and a half hours. Even allowing the time required to get out to the flying field by bus, there is some saving over railway time, and there are certainly advantages in coolness and comfort during the warm summer months. Two trips each way are scheduled, and the fare is 15 dollars one way or 25 dollars for the round trip.

The company is a very powerful combination of an old experienced transportation firm, the Philadelphia Rapid Transit Company, and of Fokker ships and Fokker pilots with long European experience in air line work The huge three-engined Fokker cabin monoplane is employed, carrying a pilot, a pilot-mechanic and eight passengers. Each passenger is allowed 30 pounds of baggage free with a 25-cent charge for each pound of excess baggage. Comfortable seats, a lavatory and a baggage compartment are provided

It is interesting to note that passengers can reserve seats from a chart of the cabin space Evidently the public is now regarding flying more seriously The advertising literature of the company carries the following very truthful statement "Aviation has passed the stage of stunt flying and thrillers and has emerged into the era of commercial development Airplane safety need no longer be judged by the antics of the loop-the-loop daredevils any more than automobile safety is now judged by the records of race-track drivers."

Broadcasting Weather

IN addition to the transcontinental line of the Air Mail Service, there are now in operation some 15 air mail contract lines in the hands of private operators. The problem of giving all such operators adequate weather information service becomes of importance.

The Weather Bureau now has 15 stations in the United States at which upper air observations with pilot balloons are made twice daily Similar stations are maintained by the Signal Corps and the Bureau of Aeronautics of the Navy Department. It is highly encouraging to note that an Interdepartmental Metereological Committee proposes to coordinate all such stations.

It is proposed to establish further stations, to advance the hours of observation from 6 A.M to 6 P.M instead of 8 A M to 8 P M as previously and to complete the telephone and telegraph weather information service by broadcasting from a number of powerful radio stations.

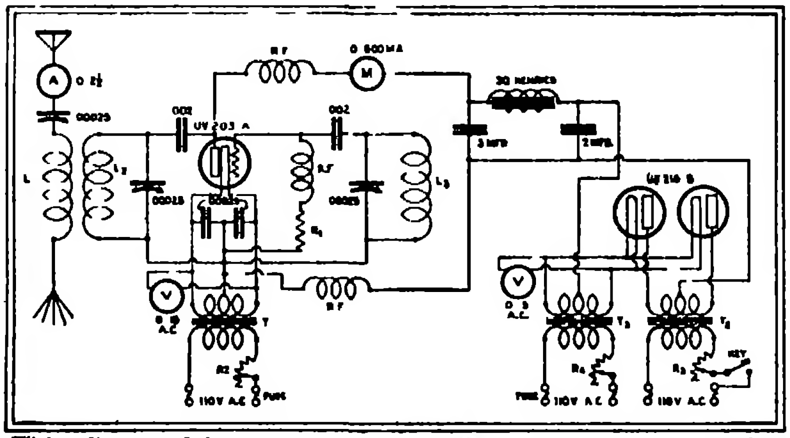
Until such time as flight can be maintained in all weathers, keeping the aviator posted on the weather in his line of flight is of paramount importance.

Wide World
Model glider meet held by apprentices of the British Royal Aircraft factory

Radio Notes

A Review and Commentary on the Progress in This Branch of Rapid Communication

Conducted by Orrin E. Dunlap, Jr.



Wiring diagram of the transmitter at station 2NZ. Data on the coils and other parts of the circuit will be found in the columns directly below

Data on Hook-ups of Station 2NZ

THE transmitter used at station 2NZ New York the wiring diagram of which is printed at the top of these columns is known as a tuned grid tuned plate' circuit It is one of the most popular of amateur transmitter installations

In reference to the diagram coils L1 and L2 are six inches in diameter and consist of eight turns of edgewise copper ribbon wound clockwise, L3 has the same dimensions except that it is wound counter clockwise L3 is placed in slight inductive relation to L2 that is the coils are from twelve to twenty inches apart RF represents choke coils each consisting of 100 turns of No 28 D C C wire wound on a tube 1½ inches in diameter R is a 5000 ohm lavite resistance R2 R3 and R4 are each 10 ohms T1 and T3 are transformers rated at 150 watts with 15 volt secondaries T2 is a plate transformer rated at 500 watts with a 1,500 volt secondary V is a voltmeter The filter condensers are rated at 1000 volts break down

The hook up of station 2NZ's short wave receiver is also shown in a diagram The primary consists of 10 turns of number 26 silk covered wire for all wavelengths wound on a form 2½ inches in diameter

Secondaries are wound on forms three inches in diameter with number 18 bare copper wire except the secondary for reception on 85 to 210 meters which is wound with number 26 silk-covered wire

Ticklers are wound with number 28 silk covered wire on forms three inches in diameter For waves from one to 30 meters the secondary has three turns and the tickler two turns, 25 to 54 meters secondary six tickler three 55 to 110 meters secondary 15 tickler six, 85 to 210 meters secondary 30 tickler nine

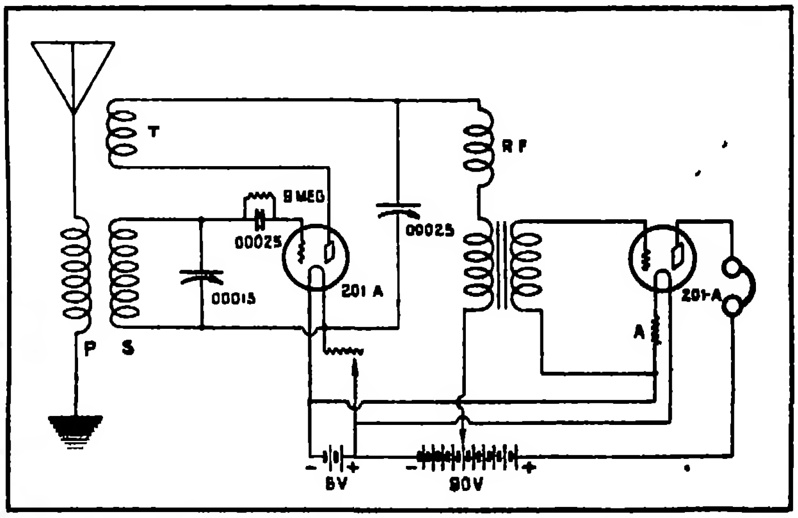
RF is a choke coil, consisting of 100 turns of number 36 silk-covered wire wound on a form one inch in diameter A is an amperite

Short-wave Tests at Deal Beach

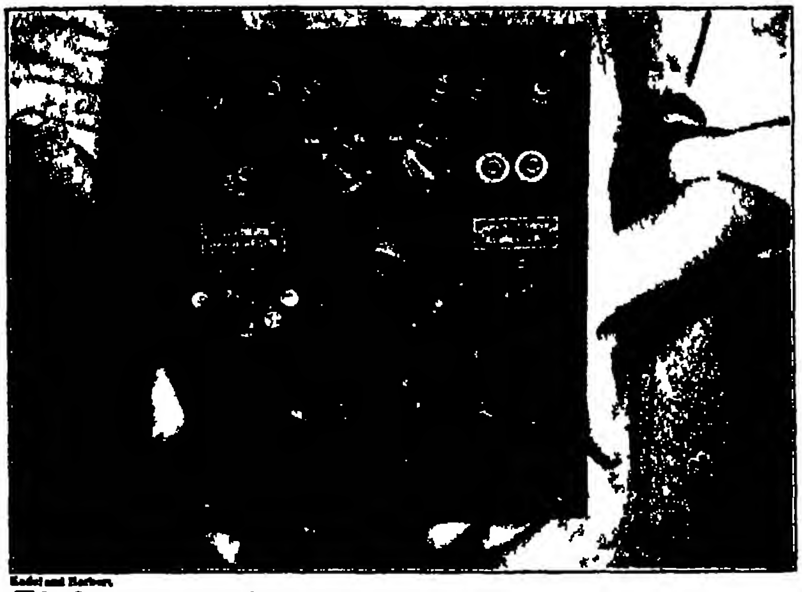
AN experimental station of the Bell Telephone Laboratories at Deal Beach New Jersey is investigating various phases of short wave transmission Field strength variations over 24-hour periods are being measured, as are also variations with change of wavelength and distance Observations are being made regarding night versus day transmission over land versus over water transmission and fading and its effect on intelligibility and quality Some of the tests are made by means of automatic recorders and others with field strength measuring sets

So far the hour by hour observations show fairly consistent characteristics and it has been noticed that long waves are attenuated less than short waves over distances up to 100 miles at longer distances the signal strength of the short waves increases In most instances fading is found to be less marked on longer waves The quality varies somewhat when the carriers and side bands fade simultaneously but the greatest variation is noticed when the frequencies do not fade at the same time

It has been found that for distances be



This is the way in which the short-wave receiver at 2NZ is hooked up. Interchangeable coils, described above, give the set a wide tuning range



Kadel and Herbert

This German army radio receiving set employs a crystal detector proving this instrument to be reliable for reception under many conditions The tuner consists of a coupler wound in banked fashion with litzendraht wire two variable condensers and two special tap switches One of the condensers tunes the aerial circuit and the other tunes the secondary

tween a few hundred and 1000 miles there is little difference between overland and over water transmission Night transmission is superior to that of the day on high wavelengths and day is better than night for transmission on some of the shorter waves The scope of the tests has been extended to include observation points as far west as Seattle

The power of the test transmitter at Deal Beach varies from one kilowatt on the shorter waves to four kilowatts on the longer wave channels The set is usually operated over a wavelength range of 16 to 111 meters

Radio Helps Ships Avoid Hurricanes

THE United States Navy is developing a system of storm warnings for mariners which will minimize the danger of ships being caught in hurricanes Weather bulletins are broadcast daily at 10 30 A M and 10 30 P M Eastern Standard Time and at noon by radio stations along the eastern seaboard The naval station at San Francisco flashes warnings at 1 30 A M and 8 P M Pacific Standard Time The plan is to have sailors plot the warnings on weather maps furnished in connection with the service

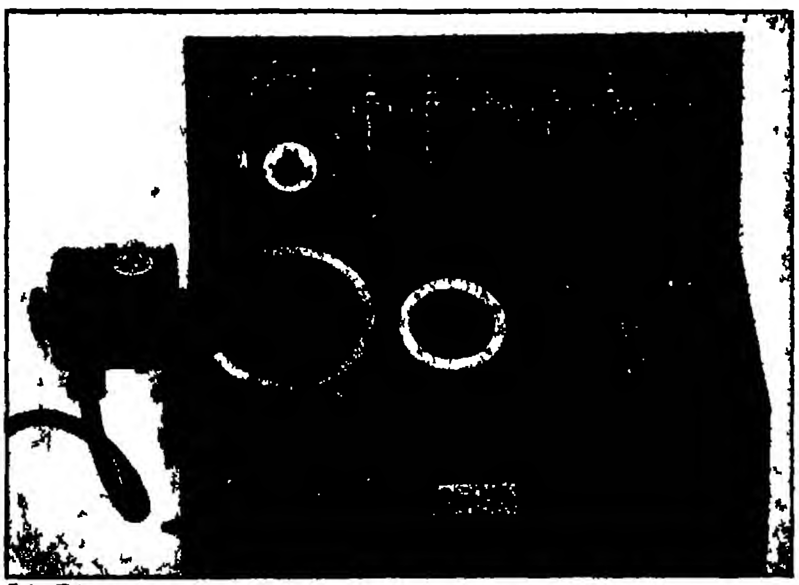
The *U S S Kittery* in frequent trips between Hampton Roads Virginia, and West Indian ports, has tested the service and has been able to pass unscathed through storms by steering out of the center of the hurricane's path On several occasions a hurricane was apparent on the *Kittery's* weather map in plenty of time to avoid the brunt of the storm

The method used by the *Kittery* is that of continuously plotting the radio weather reports chiefly barometric pressure Observations of plotted lines eventually show the rate of speed and direction of travel of the storm areas which are well defined through a fall w barometric pressure After determining the direction and speed of the areas the navigators can intelligently decide upon the best course to follow

Battery Chargers

A DEMAND for a combination battery and charging unit has been created by the fact that many radio sets require a storage battery for operation according to W C Brooks of the Hartford Battery Manufacturing Company Such a device is called a trickle charger and is designed to charge the battery at a slow rate at all times when the set is not in operation

This device is not new said Mr Brooks at a meeting of the Battery Manufacturers Association In the trickle charger a small six-volt battery is permanently connected to a rectifier which in turn is provided with



Herbert Photos

The metal box connected to the left of the radio direction-finder is attached to the ship's main gyro-compass. Variations in the latter instrument are communicated to the outer rim of the dial of the goniometer so that the true bearings can be obtained without the need of correcting calculations

Herbert Photos

This automobile might be termed a complete, traveling radio station. It is equipped with a nine-tube receiving set and a 50-watt transmitter. The owner, Capitan Plugge, will drive the car from London to Constantinople and will broadcast his experiences while on the road

a standard plug for light-socket attachment, just as an electric toaster There are four types of rectifiers used for changing the alternating to direct current after it has been transformed at the proper voltage for charging the battery All these rectifiers are similar to radio detectors.

"The four types of rectifiers are first the bulb or vacuum tube, more familiarly known as Tungar and Rectigon, second, electrolytic, which is divided into alkaline and acid, third, vibrator, fourth, crystal In the bulb rectifier a small two-element vacuum tube is employed and this is perhaps the most popular rectifier thus far

"The electrolytic rectifier was first developed and most commonly used in the alkaline type, being formed of a single cell having aluminum and lead electrodes and a borax solution. The second type of electrolytic rectifier, which is a new development, uses an acid electrolyte and some rare metal or alloy electrode and a lead electrode The most familiar combination is the tantalum rectifier This has been successfully used and is a desirable arrangement because it has approximately the same electrolyte as the battery The only difficulty with this type is a tendency to go dry in continuous operation, especially in a warm place, but if it is properly proportioned it will need water no more than a battery

"The third division of rectifiers, that of the vibrating type, may well be dismissed from consideration, because it depends upon a vibrating armature, which produces sparks creating interference for the set.

"A new type of rectifier for this service, which will probably have increasing application in the future, is the dry crystal Since the trickle charger will require only a small amount of current it seems easily possible to multiply the number of detectors until they have sufficient current-carrying capacity to operate a trickle charger There is considerable work being done on this charger at present, and undoubtedly in the near future some of these devices will be on the market"

Radio Pictures a Routine Business

TRANSMISSION of pictures across the Atlantic is developing into a routine business. The London end of the circuit is in the hands of the Marconi Wireless Telegraph Company, Ltd., and the New York end is handled by the Radio Corporation of America.

Photographs received in New York but destined for another city are forwarded by special delivery or air mail Pictures received in London are relayed to the continent by airplanes.

The maximum dimensions of a picture which can be flashed across the sea is $4\frac{1}{4}$ by $11\frac{1}{4}$ inches. The size is determined and limited by the width of the glass cylinder

Herbert Photos

Station 2DS of Brooklyn, New York, uses 100 watts of power. Signals from this station were heard by the MacMillan expedition when they were far into arctic territory. The transmitter operates on the 40-meter band

Herbert Photos

The radio voice of Lausanne, Switzerland, is rated at 1½ kilowatts. The transmitter was built by the Marconi Company and is known as the type Q

and its circumference, around which the picture is placed for transmission. Pictures or written matter exceeding these dimensions can be divided into strips not exceeding 4¼ on one side and 11⅝ on the other

The rate is four dollars per linear quarter inch or 16 dollars per inch with a minimum price of 50 dollars. A picture 4¼ by 5 inches would cost 80 dollars. An additional quarter of an inch is necessary for the transmission of an address and it is charged for at the regular rate.

Photoradiograms may be filed in the form of photographs, prints, negatives, positive films, line drawings, handwriting or printed matter The printed matter should be set in type not less than 10-point in size and a larger type is preferable.

Radio Legislation

There will be no new radio laws enacted in the United States until Congress meets in December The Senate has passed the Dill bill and the White bill passed the House Both bills pertain to radio control and conferees are now at work ironing out the differences in the two bills. It is expected that the conferees will make a report early in December when Congress reconvenes.

The White bill provides for radio control through a bureau under the direction of Secretary of Commerce Hoover and a part time advisory commission. The Dill bill would take control of radio out of the hands of Secretary Hoover and give it to an independent commission of five members, one to be appointed from each of five regional zones, into which the country would be divided The salary stipulated for the commissioners is $10,000 a year

President Coolidge has been reported as endorsing the White bill which leaves the control of radio in the hands of Secretary Hoover

Musical Appreciation

Broadcast programs designed to stimulate greater appreciation of music will be radiated by KDKA, Pittsburgh, beginning in October and continuing until May The series has been arranged by the station's musical director with the cooperation of the National Federation of Music Clubs and the Pittsburgh Musical Institute

Engineering Council to Study Radio

The American Engineering Council is seeking a "public service solution" of the broadcasting problem, according to the President of the Council, Dean D S. Kimball of Cornell University An investigating committee will be named by the Council to

P & A. Photos

This photograph shows J. P. Buckley, draftsman and designer in the Bureau of Standards' Laboratory, with a model of the directive radio beacon which is now perfected and which is designed to guide airplanes in flight. The device will undoubtedly be a great aid to night and cross-country flying

examine the entire situation which he said threatens to create a radio chaos of inestimable complexity' affecting 20 000 000 listeners

Many of the problems are fundamentally of an engineering nature said Dean Kimball and will be studied by a special committee in an unbiased broadminded comprehensive manner so that accurate conclusions may be generally available in convincing form

Alkali Vapor Used as Tube Filler

A NEW type of radio tube known as the CX 300 A using an alkali vapor as a filler has been placed on the market by E T Cunningham Inc It is designed so that in order to use the tube in the standard broadcast receiver no change in wiring or circuit arrangement is necessary although a slight improvement will be noticed if the grid return is connected to the negative filament A combination of high sensitivity and smooth regenerative action makes this tube useful in short wave receivers where radio frequency amplification is less effective

Wavelength changing on board the S S *Scythia* is a simple matter It is only necessary to manipulate one of the two switches shown above

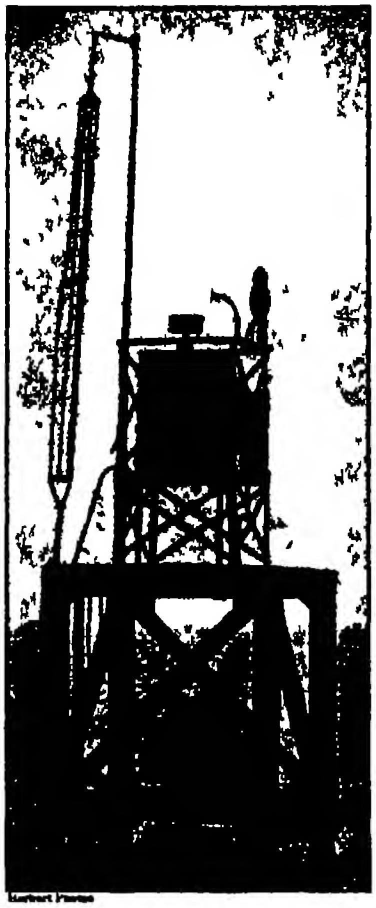
Code Still Lives

THE Morse code still exists because it is the most economical means of getting a given amount of words from one point to another in the shortest time with the least power over the greatest distance and through the greatest amount of interference

Static Useful

STATIC is good for something according to the United States Forest Service It has been found that by measuring the intensity of the atmospheric strays it is possible to forecast periods of low humidity or fire hazard by several hours during which time the forest fire fighting forces may prepare for action

Static intensity is also a good indication that thunderstorms are approaching even 24 hours in advance of any visual indications



Herbert Photos

Unattended fog signals, operated by radio are now installed on a sand bank in mid channel at the entrance to the Firth of Clyde, Scotland and at Whitefarland Point

Direction Finder for Coast Guard

A NEW direction finder has been developed by the Bureau of Standards for the Coast Guard for installation on a fleet of patrol boats The direction finder coil consists of four turns of ignition cable wound on a 30 inch frame installed above the pilot house and rotated from below A coupling it has been designed so that the loop can be attached to the ship's receiver

Harris & Ewing

Engineers say that fading is the worst obstacle to broadcast reception. This picture shows T Parkinson of the Bureau of Standards operating a portable fading recorder which makes a graph on a strip of paper as the signals wax and wane and so enables engineers to study various phases

A New Public Danger?

Ever since the advent of the automobile to our public highways the difficulties of the pedestrian in attempting to preserve his life have been the source of both serious and humorous comment on various occasions. Now we have the airplane in rather general use and it brings its own peculiar troubles. Although "pop" bottles and other objects that mark the automobile tourist can be dropped from the car while traveling with no danger than perhaps to the tires of some other vehicle, it does not seem safe to follow the same procedure from an airplane as is evidenced by the following clipping from the *New York World*, sent to us by one of our readers. Possibly this occurrence will bring forth a flock of protective devices to be worn by pedestrians, automobiles, horses, cats, cows, et cetera, in order to prevent future happenings of a like nature.

> While riding in an automobile with her family, Mrs. A. D. Montayne, of Cincinnati, suffered a severe gash in the top of her head from a soft drink bottle which crashed through the top of the car. The bottle evidently had been dropped from an airplane overhead.

Sensational

Recently Sir Jagadis Chunder Bose, Director of the Bose Research Institute, Calcutta, India, published a book entitled "The Nervous Mechanism of Plants" (Longmans, Green and Company, New York). This work according to the publishers "establishes the fact of the existence of a nervous system in plants." Other scientists claim that the fact of the existence of a nervous system in plants was known long ago and was not established by the noted Hindoo savant. "If any physiologist has had the foolish notion that plants are less sensitive than animals" writes one of them in a personal letter to the editor, "I can only say that he hasn't worked in a first class laboratory."

Recently so much sensational publicity has been accorded to other "discoveries" of the celebrated Hindoo by the newspapers and by certain magazines—notably the *New York Times Book Review*—that Dr. D. T. MacDougal, Director of the Laboratories for Plant Physiology of the Carnegie Institution and Corresponding Editor of the Scientific American, has taken rigorous issue with many of these claims. The following is a communication from Dr. MacDougal whose eminent standing among scientists is well known.

> The scientist is continually called upon to give credence to the improbable and to accept the apparently impossible. The researcher, however, can not stand receptive to sift and weigh every unsupported assertion and flying rumor retailed in the market place. Nor if he does the more important work which falls to him, can he spend much time on the purple fringe of bizarre contributions to his subject.
>
> The naive review of Mr. Van Buren Thorne of the work of the Indian scientist Bose calls for some attention because the wide publicity resulting from its appearance in the *Times Book Review* of June 20 may mislead many persons of even less discrimination than the author of the review who assumes the pose of discoverer of unappreciated genius.
>
> Bose has given many lectures in America, some of them self suggested or volunteered, and has encountered the well known American toleration to speakers from beyond any of the Seven Seas. His oral efforts, supplemented by a steady flow of books (a futile row of them is at my elbow) and by perfervid outpourings of imaginative conceptions and self praise in Calcutta newspapers widely cabled abroad, have given his work as wide a publicity as the theories of Einstein have received. Einstein's conceptions seem to endure publicity but those of Bose do not.
>
> Few of Bose's claims on other subjects stand the scrutiny which would give them place in text books and compendiums. Mr. Thorne seems to have read *much of this material but to have seen* very little that has been written *about* it and he attributes a similar non-judicial attitude to the working scientists when he says of Bose, "... his critics have not read this book." The notices and comments on Bose's work by critics in England, Germany and America to whom some degree of competence must be attributed have apparently not reached Mr. Thorne. Practically all of these state outright that the results prized so highly await confirmation, a kindly condemnation suggesting that the alleged discoveries should be supported by some actual proof by the author. The reviewer in clumsy adoration says:
>
> "In the course of these investigations he discovered and proves that plants are sensitive to minute burns and transmit impulses possibly of distress therefrom; to the effect of acids, electric shock and to the narcotic action of poisons. He also found that plants become fatigued, recovering after rest."
>
> These conclusions, in so far consonant with fact, were well established by researches made prior to Bose by as much as fifty or a hundred years. Toward their perfection Bose has contributed no serious addition.
>
> As to methods, the gradual piercing of the complex and delicate tissues of a plant stem by the gradual introduction of an Electric Probe (these caps are by author and reviewer) for example, is as rational as if a similar instrument were to be thrust gradually through human skin, muscle, rib, cartilage and membrane into arteries, veins, lungs or nerves and the resulting disturbances read on a galvanometer.
>
> Bose seems to be so impressed with the precision of his recorders and electrostatic apparatus that the vastly greater delicacy of colloidal structure, equilibria of membranes, and molecular adjustments in living matter are ignored. The wreckage which ensues when the terminals of the various apparatuses are thrust into plants seemed to be disregarded, an attitude which is perhaps wise on the part of those who have no

conception of the nature of protoplasmic mechanism. When an electric circuit is closed through the tissues of a plant, rhythmic disturbances are recorded. These pulsations on the basis of pure assumption are translated into a "pumping action" of the living cells which moves material through the stems at great speed It would be equally justifiable to take the click of car wheels on the rails as constituting the motor forces which propel a train

To attempt to analyze the formal recognition accorded Bose in Great Britain would entail a discussion of features of Anglo-Indian relations well-outside of the domain of knowledge of the fundamental properties of living matter or of the functionation of plants.

As against the harm done by reckless writing which would make a sort of animal out of plants, we may credit Bose's utterances as having done something to detach the layman from the mistaken conception that matter, living or non-living, is inert.

D T MacDougal,
Director

Laboratory for Plant Physiology
Carnegie Institution of Washington

All-inclusive

Here is an interesting proposal, submitted by Charles H Clark, a mechanical engineer, of New York Mr Clark has been studying the condensed table of ethereal waves published on page 150 of our March, 1926, issue, and believes a better and more systematic method of indicating wavelengths could be devised He has devised one, which we reproduce in these columns. If physicists and astronomers would adopt such a system as this a great many things would be simplified

Clark's Table of Ethereal Waves

Stellar Metric Scale	1,000 sm =1 skm	(stellar kilometer)	=1,000,000,000,000,000.000,000 meters
	1,000 smm=1 sm	(stellar meter)	=1,000 000,000,000 000 000 meters
	1 000 ukm=1 smm	(stellar millimeter)	=1,000,000,000,000 000 meters
Ultra Metric Scale	1,000 um =1 ukm	(ultra kilometer)	=1,000 000 000 000 meters
	1 000 umm=1 um	(ultra meter)	=1,000.000,000 meters
	1,000 km =1 umm	(ultra millimeter)	=1,000,000 meters
Metric Scale	1,000 m =1 km	(kilometer)	=1,000 meters
	1,000 mm =1 m	(meter)	
	1,000 ikm =1 mm	(millimeter)	=.001 meter
Infra Metric Scale	1,000 im =1 ikm	(infra kilometer)	= 000,001 meter
	1 000 imm=1 im	(infra meter)	=.000 000 001 meter
	1,000 akm=1 imm	(infra millimeter)	=.000,000,000 001 meter
Atomic Metric Scale	1,000 am =1 akm	(atomic kilometer)	=.000,000 000,000,001 meter
	1 000 amm=1 am	(atomic meter)	=.000 000,000 000 000 001 meter
	=1 amm	(atomic millimeter)	= 000,000,000.000,000 000 001 meter

A Correction

While we always do our best to insure accuracy in this magazine, particularly as to proper names, occasionally, as is indicated by the letter printed below, we slip up However, we admit our fault and extend our apologies to the Quincy Chamber of Commerce

Editor Scientific American

It has been called to the attention of this Chamber of Commerce that in the August issue of your magazine, in an article entitled "Giant Floating Aircraft Bases," mention was made of the airplane carrier *Lexington*, being built at the "Fall River Shipbuilding Corporation, Quincy, Massachusetts." the latter being incorrect This should read "Fore River Shipbuilding Corporation Quincy, Massachusetts."

We should be pleased to have this correction published. Thanking you for this favor, I am

Very truly yours,
John F Scott,
Secretary Quincy Chamber of Commerce.

Eagle-eyed?

Not everybody took lying down the statement quoted in the May issue of the Scientific American, page 337, to the effect that Venus was the only star that could possibly be seen in the broad daylight, even from the shady depths of a silo or a mine shaft. The letter published below was written by a member of the Springfield, Vermont, group of amateur telescope makers, described in the November, 1925, issue of the Scientific American. Mr. Marshall hopes to demonstrate that the star, *Sirius* may thus be seen. To establish beyond doubt of error the visibility of stars in daylight would prove, in the last analysis, almost as difficult as establishing the objective reality of some psychic phenomenon seen by a small number of people Mr Marshall's proposed method is at least scientific It looks as if this matter of daylight visibility of stars (except Venus, which practically everyone concedes) might turn into a controversy, and controversies are always interesting.

Editor, Scientific American:

Having seen in the recent issues of several monthlies—notably the Scientific American—discussions of the old tale about seeing stars from a well or a mine shaft, during daylight hours, my interest in the subject has been slightly stirred, chiefly by the omission of at least two important features related to vision. These features are: first, the tube or any optical instrument, particularly the telescope, and, the *individual* eye capacity, and second, the varying capacity of different optical instruments designed for bringing distant objects within closer range of the observer

I believe that while engaged in demonstrating the foolishness of thinking one may see stars by daylight, we ought in fairness to the badly informed, or to the gullibly inclined, to show under what conditions it is possible to see stars by daylight.

Take the subject of the tube first If any one has had opportunity to look through a tubeless telescope by daylight, and at the same time could compare its seeing qualities with those of an instrument having a tube, the decided difference in favor of the one having the tube would be all too apparent. Why? Because the tube shuts out all light except that which comes from the immediate vicinity of the object at which the instrument is directed Take for example a certain type of Cassegrainian telescope on which no tube is used, it is scarcely possible to get an image of the ordinary landscape at daytime, owing to the so-called "irrelevant" light This comes in at all angles from the horizontal plane of the objective in the direction of the object which one attempts to see

It is just within the bounds of possibility that sometime or other someone has seen from a deep well or coal mine shaft, perhaps at or immediately after sundown, some bright twinkling object, which he thought was a star The object may have been Venus, or possibly Jupiter It should be noted that the average person makes no distinction between a star and a planet; and not many people know that there is any difference until it is explained to them.

Concerning the individual capacity of the eye, almost everyone knows that there is a marked *difference* in the visual capacity of different person's eyes. Let any one who will, try a pair of common bird glasses which usually have a magnification of three or four times that of the normal eye. Let such a one point them to the stars and he will be astonished at the number which he can see, which the unaided eye does not note. A power of only three times over the eye is not much. I have a friend who can see, in the early twilight, stars which I find it difficult to see when it has become totally dark. And I am not

The original brick chimney as it stood for many years

afflicted with anything at all like poor vision But my friend has a most extraordinary eye

The function of the large or objective lens of any telescope binocular or field glass, is to increase the light gathering power over that which the eye possesses Here again it should be pointed out that an instrument of low power with a high light gathering capacity will quite often more clearly reveal some faint object which a higher powered instrument having a smaller light grasp will fail to show

Finally it should be borne in mind that in attempting to see a first magnitude star against a daylight sky not a little depends on how much of the surrounding illumination may be eliminated Not many weeks from now Sirius will be in the daylight skies and I shall set my instrument on it then reduce the eye piece in magnifying power until I reach the vanishing point or until nothing but the objective is in use I shall call to my aid my keen eyed friend above mentioned to learn just what he can see If he can see Sirius without an eye piece I shall try him with the tube only The results if you care for them I shall be only too glad to send to you

(Signed) O S Marshall

A Quiet Chimney Collapse

That an 80 foot brick chimney should completely collapse with no more noise than that occasioned by the passing of a heavy truck is indeed unusual One of our readers living in the town where this happened has taken the trouble to collect some data on the chimney and has forwarded it to us together with some very interesting before and after photographs

Editor Scientific American

I am enclosing a series of photographs of a very unusual occurrence in connection with the recent collapse of a brick smoke stack at the old Elder and Eckbert flouring mills in Lewistown, Pennsylvania

This brick mill and the stack were erected in 1855 The stack was eight feet square at the base and about 80 feet high built of ordinary country kiln burned red clay brick and consisted of a round inner chimney reinforced by the square walled stack all laid in old fashioned lime mortar

The foundations below the ground level are of cut stone and still are intact The stone foundations were originally well above ground but in later years gradual earth fills extended slightly above them

About 20 years ago it was discovered that frost and moisture were causing the bricks at the base of the courses of the stack to crumble and disintegrate thus apparently endangering its stability

To remove this menace and strengthen the base a supporting buttress of 10 inch concreted brick about four feet high was built around three sides of the stack leaving the southern exposure which was apparently intact without such additional support

About 12 years ago electricity was substituted for steam in operation of the mill—the brick boiler house at the base of the stack was removed—and the

After the collapse. Not a vestige of the chimney remains

stack fell into disuse, except for a small steam heating plant for the mill.

Recently it was noticed that bricks at the top of the stack were crumbling, and about 9 30 A.M., one clear, sunshiny morning several weeks ago, following a frosty night, the whole stack suddenly collapsed

An eye-witness states that the first movement was a settlement, which bulged the reinforcement blocks bodily away from the base. The top sway was directly to the northwest Then the southern base bulged out and the whole stack crumbled directly to the southeast, casting the bulk of the bricks into a depression occupied by an open wooden trestle, and in a direct and narrow path away from the base

The photographs reproduced here show the original chimney structure and the brick boiler house as it appeared in 1896, the mill site immediately after the fall of the chimney and the brick pile left by the collapse. In the latter, note the complete separation of the bricks from the mortar, caused by the shock of the fall

One concrete buttress lies as it fell and the other two are buried in the immediate front under the bricks, no part of which extend 24 inches above the roadway

So little noise was occasioned by the collapse that some of the people living in the adjacent houses, only 30 feet distant from the stack, were not aware of its fall—attributing the noise to passing auto trucks.

Had it continued its fall in the northwesterly direction, it would have undoubtedly have crushed the houses and killed or injured inmates of the three families occupying them.

I consider this a most remarkable occurrence.

Very truly,
W F Eckbert, Jr.,
Lewistown, Pennsylvania.

The pile of bricks, showing how they were completely separated from each other

Seeing Stars

Some people's eyesight is known to be better than average and it is not yet *proved* that they cannot see stars by daylight. On this point, however, most astronomers "are from Missouri," for they maintain that, with the exception of Venus, neither stars nor planets can be seen until night. What experiences have you had?

Editor, Scientific American:

While on the subject, "Can Stars Be Seen by Daylight," page 337 of the May number of the Scientific American, your readers may be interested to know that the planet Jupiter can be seen by daylight. Some twelve or fifteen years ago, one Fourth of July, I was able to see Jupiter with the unaided eye two minutes before sunset Venus and Jupiter at that time were only about ten degrees apart. Venus was easily found, and knowing the direction and distance of Jupiter, I knew its position. Within one or two degrees, I picked it up with an ordinary six-power glass and just before sunset was able to see it without optical aid.

My daughter, who is a high school student, and I saw Jupiter several times by daylight during November and December of last year. The earliest time was ten minutes before sunset Thanksgiving Day, November 26. Venus and Jupiter were near each other We could see Venus early in the afternoon but light clouds came over from the west. We were disappointed and went for a ride Forgot our star gazing and then the clouds, while obscuring the sun, broke away in the southwest and there like a diamond in the sky was the planet Venus and some 10 or 12 degrees away, the planet Jupiter

Sincerely yours,
(Signed) E. W Moore, D.M.D.

Another Telescope Enthusiast

Good luck to you, Mr. Davies! We hope your telescope will be a great success, and as you have been such an enthusiastic reader of the Scientific American we should say that you are starting with the odds very much in your favor Let us know how you are progressing.

Scientific American Publishing Co.,
Dear Sirs

The last three issues of the Scientific American (February, March and April) have interested me more than any previous copy because they dwelt to such length on a subject that has been nearest my heart for years. I have read the magazine assiduously for a long time and have studied astronomy ever since I had to stand on tiptoe to kick a duck in the pants. The desire to own a telescope has always been paramount and the recent articles have certainly fired me with an ambition to make one.

What qualifications I have, to enable me to make a telescope need to be found out, but if it takes patience and an infinite capacity for detail, I have nothing else but Pattern making has been my trade for 25 years and during this interval I have enjoyed a wide experience in automatic machinery, models and inventive work where precision counts. Perhaps I can see as far through a mill-stone as the fellow who made the hole in it As soon as I receive your book, I will be all set

I have received circular letter LC 32 from the Bureau of Standards and also a copy of Monthly Notices for March, 1909, from the Royal Astronomical Society, London. The article in this issue by the Rev. C. P Davies, on mirror making, is excellent, but he lays particular stress on the point of zonal measurement and abberations. This may be my stumbling block. We shall see if the scientific training of the Davies family can be carried on.

Very sincerely yours,
Kenneth Davies,
Hollywood, California.

Commercial Property News

A Department of Facts and Notes of Interest to Patentees and Owners of Trademark Rights

Conducted by Milton Wright

Don'ts for Inventors

YOUR patent attorney, who is registered to practice in the United States Patent Office, is not likely to be the man to seek to steal your invention. You can trust him with all the facts you have about your invention. He needs all those facts in order to get you the best patent possible. Withholding information from him may even result in a patent that is invalid. *Don't hesitate to give your patent attorney all the information he asks.*

Some inventors are even so careful that they fear to disclose all the facts to the Patent Office itself, not realizing that the Patent Office must know all about the invention before it can give it the protection of a patent. *Don't be afraid to trust the Patent Office.*

Tradeless Trademarks

SUPPOSE you thought up a corking good trademark, but had no commerce to use it with. Could you have the mark registered in the Patent Office?

You could not. The mark must be used in interstate or international commerce or in commerce with Indian tribes before it can be registered.

This principle is emphasized by Acting Patent Commissioner Kinnan in refusing the application of the Los Angeles Creamery Company to register as a trademark the notation "Electruck." In an effort to comply with the law, the company had a truck bearing the mark driven over the Mexican border and back again in going from one section of California to another, but it was not contended that any sales were made outside the state.

"The only condition under which the Patent Office obtains jurisdiction to register a mark is where the owner of the trademark seeking registration has used it in commerce with foreign nations or among the several states or with Indian tribes," says Commissioner Kinnan. "Unless so used the applicant for registration has no standing under the statute. It is well settled that such activities as the applicant has shown do not establish trademark use in commerce with foreign nations or between states."

Cook Book for Export

IT is all very well to export American food products to Europe but what are the Europeans going to do with them when they get there? J. R. Wilkinson, American Consul at Zurich, Switzerland, has the answer. Distributing cook books in foreign markets may prove an aid to the sale of American prepared foods abroad, he suggests to the Department of Commerce.

Mr. Wilkinson states that in Switzerland the housewives are very much interested in acquiring a knowledge of cookery from recipe books and are using the books widely. One or two instances have come to his attention, he states, where sales of certain American products were materially increased by the local distribution of cook books setting forth directions for preparing certain dishes using these products. The books are printed in French and German.

Utmost care should be taken according to Mr. Wilkinson, in the translation of the books on account of the diversity of dishes in various countries. For example, instruction for pie making would be very difficult if the translator had never seen an American apple or pumpkin pie.

Wide World

The convenience of traveling on a certain transportation line in London, England, is now enhanced by the installation, in stations, of the "pathfinder" device illustrated above. When one is in doubt as to the car that must be taken, it is only necessary to press a button labeled with the name of the desired destination and an indicator on the map will show the required information. The route covered is traced by illuminated dots. Not only is the most direct way to the destination given, but an alternative one is indicated

Patents Recently Issued

Classified Advertising

Advertisements in this section listed under proper classifications, rate 25c per word each insertion, minimum number of words per insertion 24, maximum 60. Payments must accompany each insertion.

Official copies of any patents listed in this section at 15c each, state patent number to insure receipt of desired patent copy.

Pertaining to Apparel

GARMENT SUPPORTER.—Adapted for use on men's trousers, in place of buttons, to engage with the ends of suspenders and the upper edge of drawers. Patent 1590085. J. M. Scallen, Soldiers' Home Hospital, Sawtelle, Calif.

ADJUSTABLE CAP.—Designed to permit of various head sizes by virtue of adjusting straps attached at their rear ends to the sides of the cap. Patent 1593452. A. Hertzman, 115 So. 7th St., Louisville, Ky.

Chemical Processes

METHOD OF TREATING WOOD.—For fireproofing and waterproofing the same, comprising submerging in a solution of salicylic acid, and carbonate of soda, allowing to dry and applying a solution of hydraulic cement. Patent 1591752. W. P. Ferguson, 28 Cambridge Place, Brooklyn, N. Y.

REFINING PROCESS OF SUGAR JUICES BY CHLORINATION.—By blowing chlorine gas into sugar juice at a temperature of not more than 55 degrees Centigrade, and removing the active chlorine by adding an alkaline material. Patent 1591870. S. Ochi and F. Kotera, c/o T. Yuasa and R. Asamura, 819 Marunouchi Bldg., Tokio, Japan.

Electrical Devices

VARIABLE CONDENSER.—A double capacity apparatus wherein the parts may be independently roughly tuned, and then simultaneously adjusted for very fine tuning. Patent 1592775. O. G. Lissen, 151 Highland Ave., Jersey City, N. J.

ELECTRIC DISTRIBUTING SYSTEM.—Which may be used for molding in the wall of a room, to receive any number of connecting units in any desired position. Patent 1590,-500. W. J. Fisk, 1523 A Turk St., San Francisco, Calif.

PLUG CONNECTION.—Which permits the two parts of the plug to be cast in such manner that the openings are provided when the parts are cast. Patent 1593084. A. H. Kline, 3581 Medill Ave., Chicago, Ill.

ELECTRIC PERMUTATION SWITCH.—By means of which a plurality of electric circuits having a common source of supply may be selectively closed or opened. Patent 1594288. H. D. Wethling, 318 Main St., Orange, N. J.

AUTOMATIC TURN OFF SWITCH AND LOAD-LIMIT DEVICE.—Which may be used for overcoming the danger of fire due to loading a circuit to a fuse capacity and then fusing more heavily. Patent 1594006. L. S. Foltz, Michigan State College, East Lansing, Mich.

RADIOCOIL.—In which the woven strands of wire will be overlapped and intertwined so that there will be no possibility of the wires becoming disassociated. Patent 1594,-202. A. E. Zierick, 323 E. 90th St., New York, N. Y.

Of General Interest

TRAVERSE ATTACHMENT FOR CURTAIN RODS OR POLES.—Wherein a clamping jaw is provided for gripping a rod, and means for firmly holding a single or double pulley wheel. Patent 1580550. H. Reubel, 107 E. 17th St., New York, N. Y.

FLOAT VALVE FOR FLUSH TANKS.—Which utilizes the pressure of the water supplied to the flush tank for closing and opening the valve and maintaining the valve tightly closed. Patent 1580786. A. O. Bradshaw, Los Angeles, Calif.

PORTABLE TENT.—Constructed to be transported upon the running board of an

What Is Mahogany?

CEASE and desist orders recently issued by the Federal Trade Commission against the Indiana Quartered Oak Company of New York, the Jones Hardwood Company of San Francisco, and the Thomas E. Powe Lumber Company of St. Louis are of particular interest to lumber importers, lumber dealers, furniture manufacturers and purchasers of household furniture. These companies are prohibited from using the term "Philippine" mahogany as applied to a wood which is not genuine mahogany.

The dissenting opinion of Commissioner Humphrey is especially interesting, however. He quotes the Interstate Commerce Commission to the effect that "the term mahogany applies to woods in two senses, the botanical sense and the commercial sense," and says:

"The 'milk in the cocoanut' in this controversy is that Philippine mahogany, being a product of one of our insular possessions, is admitted into this country free of duty and this fact, together with the fact that it grows in considerable bodies, instead of single trees, as other mahoganies, enables it to be sold in the United States at a lower price than the other mahoganies, and its qualities are so appealing that it is becoming a serious competitor of the mahogany association."

After declaring that to lay down the rule *that it is misleading to describe woods commercially* other than what they are botanically, would injure, if not destroy, one of the greatest industries in the country he continues:

"One of the finest woods in the world that furnishes perhaps more of the timbers used in construction today than any other is the Douglas fir of the Pacific northwest. It is known by this name throughout the world and by this name its qualities are well understood. Botanically this wood that enters so largely into the commercial life of a nation is a false hemlock. There is a widespread prejudice against hemlock, because of the qualities of that wood in the east. For the lumber producers of the northwest to be compelled to mark their product under its botanical name—false hemlock—would be to work incalculable injury to the industry."

General Burnside's Burnsides

THE lawyer who protested that there is no ivory in Ivory soap, no gold dust in Gold Dust washing powder and no bull in Bull Durham, now is joined in the annals of advertising legal lore by Alan Fox, attorney for Colgate and Company. The case was that of Ella C. Patterson, of Milwaukee, suing in New York for $150,000 damages because the shaving cream manufacturers featured in an advertisement the whiskers of her distinguished uncle, General Ambrose E. Burnside.

There is no disrespect to Washington because a coffee has been named after him nor to Lincoln, whose name is borne by an automobile, declared the lawyer. Neither have the descendants of Lord Chesterfield or Robert Burns complained to the cigarette and cigar manufacturers. English royalty has brought no action because the name of Queen Victoria's consort was bestowed on a frock coat.

Justice Erlanger, in deciding that the soap company could not be restrained from using the general's picture, said:

"Until the Legislature shall declare that the *publication of the picture of a dead* person without the consent of the heirs or next of kin is illegal, no action can be maintained either on the theory of libel or violation of the right of privacy."

automobile, yet when assembled will form a sleeping appliance. Patent 1590072. P. J Belanger, Lake City, Minn

COMBINED PIPE SUPPORT AND CLEANER.—Which prevents spilling of ashes, embers, by holding pipe bowl upright Patent 1594311 Marcell Ludasy, Box 5, Lansing, Michigan.

SAMPLE CARD.—Adapted to receive sample carrying slips, as a single sheet or in book form, and arranged vertically or horizontally Patent 1590098. J Joseph, 447 E. 174th St., New York, N. Y.

COPING.—To be used in lieu of glazed tile copings, being of metal which will effectively interlock with a cement filling Patent 1590119 H C Partridge, 1370 Flatbush Ave., Brooklyn, N Y

FILING SYSTEM FOR PHONOGRAPH RECORDS.—For safely and compactly storing records, despite their fragile character and for rapidly selecting a particular record Patent 1590148. E Bergdal, Box 871, Seattle, Wash.

IRRIGATING DEVICE.—Adapted to discharge water beneath the surface in close proximity to the roots of young trees, shrubbery, and plants. Patent 1589400 H A Klingle smith, Macomb, Ohio.

CONCRETE BLOCK AND WALL CONSTRUCTION.—Wherein reinforcing means serve as a bond between the adjacent blocks when the wall is built up. Patent 1587027 J Teege, Bagby, Calif.

DETACHABLE HEEL FOR SHOE.—By means of which a dealer may readily provide a shoe with a leather or rubber heel according to the customers' desire Patent 1588684 M. Mayorowitz, c/o Sidner, 1338 Prospect Ave., Bronx, N Y

SLED.—Having runner sections capable of adjustment to act as a brake for bringing the sled to a sudden stop in an emergency Patent 1589110. F J Caronia, 218 Kingsland Ave., Elmhurst, N Y

CURLING IRON.—Which embodies means for facilitating the wrapping or curling of strands of hair for the curling thereof Patent 1589117 J R. Cotter, 1160 Gates Ave., Brooklyn, N. Y.

FILING DEVICE.—Comprising a support, fixed and movable spindles secured thereto and means for moving the movable spindle to alignment or disalignment. Patent 1588-947 W L. Dinsmoor, c/o Central Natl Bank, Pasadena, Calif

APPARATUS FOR PRESERVING PERISHABLE SUBSTANCES — Such as vegetables and fruits, wherein the parts are so arranged as to be readily removed for cleaning or sterilizing. Patent 1589215 C De F Ordway, Burlington, Vt.

WINDOW WEDGE.—Which will serve the dual purpose of limiting the sliding movement of the sashes, and preventing rattling Patent 1589231. S J Rumbold, R D 2, Nicholson, Pa.

SUBMARINE RELIEF VALVE. — Whereby communication with men in sunken submarines may be maintained, and also air and food supplied, and gas or liquid removed Patent 1589113 E L Chisling, 2 W. 47th St., New York, N. Y

GRAVE MARKER.—In which a standard for supporting the inscription bearing tablet, may be driven into the ground at the head of the grave Patent 1589190 J M McNeill, 1015 Main St., St. Joseph, Mo

GARMENT HANGER.—On which the garment is fastened to the hanger, thus preventing the garment from slipping off or being stolen Patent 1589213. H Nygren, 815 Crescent Place, Chicago, Ill.

PIPE CLEANER.—For the cleaning of sewer pipes, may be slidably actuated, reciprocated and gyrated for cleaning and scraping the inner walls Patent 1588737 G. Hurd, 1427 Clay St., Napa, Calif.

FRUIT-PICKER'S RECEPTACLE.—In the form of a pail, which conforms to the contour of the body, prevents undue bruising of the fruit, and facilitating the picking. Patent 1589077. H. S. Hooper, c/o A. L Humboldt, San Francisco, Calif.

METHOD OF BLEACHING SOLE LEATHER.—Which consists in dipping the leather in a number of solutions adapted to produce after drying a uniform color not subject to cracking. Patent 1588686. J Raisor, c/o D. S. Mareerean Office of Clerk, Union, N. Y.

CLASP.—For use in connection with watch fobs for locking the same in a reliable manner against accidental or unauthorized removal. Patent 1588630. H K. Smith, 56 Pier Ave, Hermosa Beach, Calif

ARTIFICIAL BAIT.—Adapted alike for trolling or still fishing, and for movement through weeds and other water plants without catching. Patent 1588600 E. J Babbitt, 35 E. 8th St., Holland, Mich.

FOLDING TABLE.—A foldable frame provided with legs and hinged means for a top, which permit the top to be located in a plurality of positions either when the frame is extended or folded. The inventor has been granted two patents 1588759 and 1588,760 F C Lewis Ethical Culture School, Central Park, West and 63rd St, New York, N Y

WELL TUBING.—More particularly a screening device adapted to be incorporated in a well tube of usual construction, to permit the infiltration of liquid Patent 1588,-920 P O Trahan and F M Kile, Gueydan, La.

FRUIT PICKER'S BAG.—Including means by which the entrance end is held open, and a yielding action allows comfort to the packer's body Patent 1588004 W L Chambers, 118 So Main St, Los Angeles, Calif.

REFRIGERATOR.—Having means for supporting articles so that they will move to position within the food compartment when the door is closed Patent 1589306. J M Short, 1020 E. 8th St, North Little Rock, Ark.

STEAM TRAP.—Which will operate from low to high temperature without necessitating any adjustment, and will not be damaged by varying temperatures Patent 1588019 W Telfer, Manitoba Sanatorium, Ninette, Manitoba, Canada

FIRE PREVENTING AND EXTINGUISHING MEANS.—For preventing combustion of inflammable liquid in a storage tank and extinguishing the flame should the liquid become ignited Patent 1590877 W Black, 4844 Constance St, New Orleans, La.

POULTRY FEEDER.—In which the distribution of feed from the hopper may be regulated, and is actuated by the movement of the poultry Patent 1590090 J Rout, Canandaigua, N Y

STRAINER CUP FOR VARNISH AND THE LIKE.—For wiping the excess varnish from a brush and straining the excess as it passes back into the cup Patent 1590572. A. Fredett, 1021 W 32nd St Chicago, Ill

CHIMNEY STOP.—For fireplace openings, securing a cover substantially air-tight to prevent the passage of cold air and dust. Patent 1590306. J H Sutton, Box 144, La Grange, N C

MAIL BAG LOCK.—Permitting the ropes movement in one direction to close the mouth of the bag but preventing movement in a reverse direction Patent 1590258. R L Shannon, 501 Lyman Ave, Oak Park, Ill

WATER COOLER.—Having an assemblage which may be associated with any demijohn for serving to control the flow of water through the cooling chamber Patent 1591-709 G W Tinapp, 5313 6th Ave, Brooklyn, N Y

UMBRELLA AND RIB TIP THEREFOR.—The tip being of novel form to provide for a novel and characteristic manner of securing the umbrella cover to the tip. Patent 1591,-880 M Ornstein, c/o S Ornstein & Sons, 174 Madison Ave, New York, N Y

CABINET AND CARRIER LOCK THEREFOR.—Wherein metallic shelves are provided each shelf being formed with a depending resilient support having finger holes for reaching the tickets. Patent 1591774 O S Paysant, 106 E. 42nd St, New York, N Y

BELL BUOY.—In the nature of a spar buoy carrying bells, primarily intended for the convenience of navigators of relatively small craft. Patent 1591751 G A Ebert, Egg Harbor City, N J

SMOKING DEVICE.—Which cooperates with the usual type of pipe stem passage for preventing the same from clogging up with tobacco and nicotine. Patent 1591742. J C. Cady, 29 Broadway, New York, N Y

GARMENT HANGER.—Readily collapsible when not in use, can be packed away in a small space such as a suit case. Patent 1591334. J P Paddington, c/o Paddington Sales Co., 516 E. 72nd St., New York, N Y

ATTACHMENT FOR BOATS.—For deflecting outwardly from the sides of the hull of a boat water which would otherwise impinge with relatively great force Patent 1591748. F. C. Dieckmann, 910 Kirbert Ave, Cincinnati, Ohio.

TOBACCO AND PIPE POUCH.—With ample provision for the tobacco and a convenient pocket for the pipe the tobacco affording a cushioning for the pipe Patent 1591340 E. S Steinhardt, 8846 76th St., Woodhaven, N Y

CLOSURE OPERATOR AND RETAINER.—For releasably securing and holding a swinging closure in any one of a plurality of different positions. Patent 1591650 W A Tomlinson, R. 5, Box 46, Phoenix, Arizona

HIGHWAY CONSTRUCTION.—Providing means in the roadbed of a highway for forcing an approaching vehicle to slow down on coming near a railroad crossing Patent 1590526. E. D Kinney, P O Box 827, Twin Falls, Idaho

SHOE SOLE.—For stitch-down" shoe structures, which is comparatively simple, inexpensive and highly efficient in its purpose Patent 1592751 G F Azzara, 388 Melrose Ave, Brooklyn, N Y

KNOCKDOWN TRELLIS.—Capable of being spread out in fan like shape for use in connection with plants and flowers may be readily packed for storage Patent 1592764 H A Hamilton and D J Enright, c/o H A Hamilton 54 Magnolia Ave Jersey City N J

CONDIMENT HOLDER.—Having means for closing the openings in the top when in upright position, without interfering with its free use in dispensing position Patent 1592035 M P Massaro, Deerwood, Minn

REPAIR DEVICE FOR RULES.—A simple, cheap and effective means for connecting breaks in jointed rules, adjacent or between the joints. Patent 1592811 F W Fleer 281 Tompkins Ave, Brooklyn, N Y

COMBINED MILK BOTTLE OPENING AND COVER.—Constructed to take the place of the regular cover on a milk bottle after the latter has been removed Patent 1590557 R R Spikes, 1147 7th St, Fresno, Calif

INCUBATOR.—Having means whereby all the eggs may be turned in a single operation without endangering the life of the embryo chick. Patent 1590640 S R Ramsay 347 No Branciforte Ave, Santa Cruz, Calif

CARD INSCRIBING DEVICE.—By means of which an inscription may be made upon a card with sealing wax or the like having the appearance of embossing Patent 1592118. J W Munn, 2740 Hampden Court, Chicago, Ill

POULTRY FOUNTAIN.—Which affords facilities for holding drinking water fed until a predetermined level has been reached, and then automatically stopped Patent 1593172 M W Heatherington, R. F D No 2, Orlando, Fla.

HEAT INSULATED VESSEL.—For carrying different commodities whose mixture is to be avoided and whose hot or cold state is to be preserved Patent 1593142 A M Serun Wewoka, Okla

METHOD OF INSTALLING MUSHROOM PILING.—In beach sand, the sand forming a mold into which concrete may be poured, no special means being required for forcing the concrete into mushroom shape at the base Patent 1593415 J V Ferry and A P Miller c/o James Ferry Co Virginia and Mediterranean Aves, Atlantic City, N J

NONREFILLABLE BOTTLE.—Which will readily permit the proper emission of the contents, but whereby the parts when assembled cannot be removed without destruction Patent 1593464 G A Pagonis, 5 Columbus Circle, New York, N Y

CONTAINER.—For use in motion picture studios, or places where scraps of nitro-cellulose film or combustible material must be disposed of Patent 1593402 F Nully, 308 W 18th St, New York, N Y

SECTIONAL BUILDING.—Which may be readily set up in the field to form a complete building, after which the wall coverings may be placed thereon Patent 1593424 P L Braunworth, Walnut St., Bloomfield, N J

METAL STAIRWAY CONSTRUCTION.—Which is comparatively simple in its construction and mode of assembly, eliminating rivets and bolts, yet is strong and durable Patent 1593418. E. Berson, 1784 Bryant Ave, New York, N Y

APPARATUS FOR THE RECEPTION AND TRANSMISSION OF SOUND.—Constructed to preserve the purity of the sound and prevent the formation of parasitic noises caused by vibrations. Patent 1593457 G Lakhovsky, c/o C Chassevent, 11 Boulevard de Magenta, Paris, France.

OPTICAL DEVICE.—The operation of which will produce exceedingly harmonious color schemes which will attract instant attention to any particular location Patent 1593419. S M Bielocki, 43 W. 177th St., New York, N Y

CURTAIN TIE AND SHADE PROTECTOR.—Which not only supports the lower ends of the curtains in a graceful position, but prevents the corners of the shade tearing the curtain Patent 1593156 F M. Barsch, 812 Eveline St., St. Joseph, Mo

PICTURE FRAME.—Formed from metal, and so constructed that it may be used upon a wall, or upon the polished surface of a desk, without scratching the same Patent 1594339 I W Robertson, c/o Robertson Metal Arts Inc, 210 E 40th St., New York N Y

FOOT RULE.—For use by footwear salesmen wherein an adjustable stop is provided formed to remain in any position in which it is left Patent 1594255 W T Goldsmith, 301 Mulberry St, Newark N J

SOIL-PIPE CLEAN OUT CLOSURE DEVICE.—Which greatly facilitates the closing and opening, yet when in closed position is fluid tight and prevents the escape of noxious gases. Patent 1592382 A N Mann, 542 West Belgrave Ave, Huntington Park, Calif

Hardware and Tools

CHEESE CUTTER.—Having means whereby a cut of predetermined width may be made, and the segment of cheese easily removed Patent 1591830 I S Karraz, Brinkley, Ark

RAKE.—Having an attachment in the form of flat spring teeth especially adapted for removing light articles such as leaves from the ground Patent 1591738 C H Bell, c/o J M Shaw, Bellport, L I, N Y

MICROMETER.—In which the parts may be capable of being adjusted to each other to an extent sufficient to compensate for wear Patent 1591740 J Brewer, 1328 Hoe Ave, New York, N Y

ANGLE BRACKET.—Constructed of cheap metal and shaped to connect two members at right angles, and provide a strengthening and bracing medium. Patent 1591800 G P Wiedman, c/o Wiedman Body Co., North Tonawanda N Y

WRENCH.—Having means in connection with the shanks to adjustably limit movement of the jaws away from one another Patent 1592750 A K Ersland, Box 303, Manhattan, Calif

GALOP COCK.—Which will be actuated by gravity to close tightly even though wear has taken place on the relatively movable parts Patent 1592350 F A Fields, c/o E. S Rutherford, Three Sands Okla

BALL BEARING.—Which will be effective either as a radial or as a thrust bearing whether the thrust be in either direction Patent 1591305 M G McNeely, Oakland, Calif

SAFETY RAZOR.—So adjustable relative to the handle that any desired shaving angle may be obtained, and the usual barber stroke permitted Patent 1593450 D H MacFalls, 70 Delap St, Jamaica N Y

PIPE BENDER AND VISE MOUNT.—Which may be advantageously employed for bending or shaping a pipe or rod as desired Patent 1593703 M Chapin, 11700 Ilene Ave Detroit Mich

METAL PAIL AND COVER.—Whereby the pail may be effectively sealed to prevent dilution or substitution of its contents yet may be readily opened without tools Patent 1593633 S M Johnson, c/o Ohio Pail Co., Middlefield, Ohio

FAUCET.—From which water may flow in a uniformly smooth stream when the faucet is open but will instantly stop on the closing Patent 1593068 J J H Edling, 4058 W Euclid Detroit, Mich

Heating and Lighting

HEATING APPARATUS.—For stoves, with which is incorporated a hood having openings at the top through which the heated air is discharged Patent 1591161 C E. Draper, Elks Club, Indianapolis, Ind.

WATER HEATER.—Of the kitchen type, by which water may be heated in the boiler or in the external pipe when a limited quantity is desired Patent 1592800 H G Wellage, Crete, Neb.

KILN.—So constructed that heat not needed in any kiln of a series, may be collected and transferred to another point for use Patent 1594315. M M. Minter, 918 Broad St., Columbus, Ga.

AUTOMATIC OIL BURNER-CONTROL APPARATUS.—For use where furnaces are heated by fuel oil, to control such burners and ignite them when the temperature falls below a predetermined point. Patent 1591401. E. C. Wills, 330 Grove St., Newark, N. J.

Machines and Mechanical Devices

SAFETY ATTACHMENT FOR LEVELING DEVICES.—Relating to a braking or locking device for leveling attachments of harvesters or the like. Patent 1588197. H. C. Scott, Pomeroy, Wash.

CHECKING MECHANISM.—Particularly adapted for checking the movement of a door to closed position in order to prevent slamming. Patent 1586901. T. De W. Hubbell, 1605 So. Hoover St., Los Angeles, Calif.

METHOD OF AND MACHINE FOR FORMING SEAMLESS TUBING.—Whereby seamless tubing can be made directly from molten metal accurately and in less time than by usual methods. Patent 1590123. E. C. Riebe, 5 Place Vendome, Paris, France.

TOY CARNIVAL.—Comprising a plurality of toy units with mechanical means for operating all of them simultaneously in their respective modes. Patent 1589482. P. A. Sapp, c/o Kiddies Karnival Corp., Eufaula, Ala.

GRADIENT METER.—Controlled by a magnetic pendulum, the vibrations of such pendulum being clamped by its enclosure in a sealed box of fluid. Patent 1589767. W. Tapley, c/o W. K. Gunong, Digby, N. S., Canada.

DECORTICATING FIBROUS MATERIALS.—By feeding the material between rotating rollers which are also moved longitudinally in relatively opposite directions. Patent 1590085. H. J. Craymer, c/o H. J. C. Forrester, 88 Chancery Lane, London, W. C., England.

PIN SETTING APPARATUS.—Which will automatically set the pins of bowling alleys and will also return the balls to the players. Patent 1590124. P. Roble, c/o A. Martinez, Columbian Bureau of Information, 1440 Broadway, New York, N. Y.

FLOOR POLISHER.—For use as an attachment for vacuum cleaners, adapted to hold a polishing agent in frictional contact with the surface traversed. Patent 1588043. J. F. Clark, 308 Hass Bldg., Cor. 7th and Broadway, Los Angeles, Calif.

PRINTING PRESS.—In which the drive for the various rolls is considerably simplified by the use of a chain passed around them. Patent 1587772. W. H. Granger, 323 De Young Bldg., San Francisco, Calif.

SOUND RECORDING AND REPRODUCING DEVICE.—By means of which, speeches or songs made by actors while a motion picture is being produced may be recorded in synchronism with the taking of the picture. Patent 1588706. E. E. Cothrau, Wright, Calif.

POCKET-CLOTH MEASURING MACHINE.—Which is sufficiently small to be carried and operated by hand, and readily moved along the cloth, or the cloth moved therethrough. Patent 1589184. S. Levy, 5 Bridge St., Paterson, N. J.

SELECTOR MECHANISM FOR TYPEWRITERS.—Adapted to be used when connected with an electrically operated typewriter, or an electrically actuated mechanism for an ordinary typewriter. Patent 1589159. G. A. Henriques and A. Diaz, c/o Henriques & Diaz, 121 W. 70th St., New York, N. Y.

AUTOGRAPHIC REGISTER.—More particularly to mechanism for holding, and for facilitating the feeding of paper on rolls. Patent 1589223. W. E. Pratt, 645 Mill St., Reno, Nev.

PROCESS FOR THE PRODUCTION OF WOOD PULP.—Consisting in cutting wood across the grain into short blocks, crushing the blocks into slivers, and beating the same into pulp in the presence of water. Patent 1587790. H. F. Puttaert, 2020 Webster St., San Francisco, Calif.

DISPLAY DEVICE.—Whereby a series of advertisements can be successively displayed through a suitable opening, and illuminated selectively by colored lights. Patent 1589282. G. Chortanian and C. Atamian, 440 7th St., West New York, N. J.

MACHINE FOR MOLDING INSOLE FLANGES.—Into a predetermined shape thereby making them more readily accessible to the anvil of a lasting machine. Patent 1590004. A. H. Prenzel, Halifax, Pa.

LOADING AND CONVEYING MECHANISM.—Having novel flights positioned at such an angle to the belt that material will be conveyed without danger of rolling or slipping. Patent 1590883. C. A. Bryant, c/o Portable Machinery Co., Passaic, N. J.

MERRY GO-ROUND.—Which may be turned by children, either by engaging the ground with their feet, or by grasping the merry go round arms and running about the axis. Patent 1590887. H. D. Clayton, Hill City, Kansas.

ATTACHMENT FOR ADDING MACHINE.—Easily applied and removed, will effectively prevent the operation of the machine unless certain parts are in proper position. Patent 1590046. J. R. Kaiserman, c/o R. M. Keister, Bozeman, Mont.

CONVEYER BELT.—Having cleats that will be particularly effective in retaining the load and minimize any tendency of the material to roll back. Patent 1590884. C. A. Bryant, c/o Portable Machinery Co., Passaic, N. J.

OPERATING MECHANISM FOR ICE CREAM FREEZERS.—Whereby the operator may utilize an easy back and forth movement to impart a continuous rotary movement to the dasher shaft. Patent 1591337. F. G. Scott, 3225 Palmyra St., New Orleans, La.

HIGH SPEED FREE CHAIN HOIST.—Well adapted for use by linemen and others for elevating and tensioning heavy rods, wires, cables and the like. Patent 1591362. F. W. Coffin, c/o Lockwood & Lockwood, Fletcher Trust Bldg., Indianapolis, Ind.

PACKING.—Which is leak proof and automatically self adjusting to compensate for wear on the relatively moving parts, and temperature changes. Patent 1591876. C. A. Neal, Rock Mart, Ga.

WINDMILL SAFETY PIN.—Which will automatically turn to the safety position and prevent displacement, but may be readily positioned for convenient removal. Patent 1591781. C. F. Ried, Palmyra, Neb.

MACARONI MACHINE.—For forming macaroni of twisted or spiral form, and in addition providing a hollow passage therethrough. Patent 1592769. V. Imparato, 183 W. 97th St., New York, N. Y.

SHOP OR PLATFORM RAISING DEVICE.—For use as a substitute for scaffolding, which may be used as an individual elevating device or for supporting one or more workmen. Patent 1592770. C. Liberman, 1732 Madison Ave., New York, N. Y.

WINDMILL.—Having a plurality of fans adapted to revolve in opposite directions on a common axis to increase the power development. Patent 1590405. P. R. Campion, Stratford Hotel, 211 No. 1st St., San Jose, Calif.

DECORTICATING MACHINE.—Which automatically grips the leaf, strips the skin therefrom, takes off the pulp, presses the fibers and delivers the fibers to a given point. Patent 1592761. A. Frey, San Juan de Guadalupe, Mexico.

PORTABLE TAPPING MACHINE.—For use in drilling and tapping pipes while the latter are in service conveying gases or liquids under pressure. Patent 1592754. T. F. Brackett and G. H. Boyd, c/o Munn, Anderson & Munn, 24 W. 40th St., New York, N. Y.

PIPE CUTTER.—Which is mounted upon a movable base that is adapted to be adjusted with respect to the vise that holds the pipe. Patent 1592169. F. J. Wilkinson, 3648 Monroe St., Gary, Ind.

AUTOMATIC AND MANUALLY CONTROLLED CUT OFF VALVE.—The automatic controlling element being not only collapsible under excessive heat, but also the valve may be manually released for closing from a distant point. Patent 1592403. E. C. Wills, 330 Grove St., Newark, N. J.

SPINDLE DRIVER.—Using a non-circular shaped spindle which will positively retain a shaft to rotate, at the same time permit free longitudinal movement. Patent 1592133. H. C. Brewster, c/o Oil City Iron Works, Shreveport, La.

Prime Movers and Their Accessories

MOTOR.—Driven by the hydraulic medium, and embodying oscillating cylinders, with each of which is associated an automatic distributing sleeve, which eliminate valves. Patent 1590225. C. L. Boisset, 436 Girod St., New Orleans, La.

CARBURETOR.—Having a venturi with inclined or tapering blades, bringing about a more perfect atomization, better combustion, and using a minimum of fuel. Patent 1591,553. A. Faber, 119 W. 95th St., New York, N. Y.

INTERNAL COMBUSTION ENGINE.—Having control means governed in such manner that when the engine is running slowly little liquid is introduced, while as the engine speeds up liquid is increased. Patent 1590,574. W. Goodfellow, 342 Lester Ave., Oakland, Calif.

Railways and Their Accessories

METAL CROSSTIE.—Having great strength and resiliency, special reinforcing means being provided for that portion of the tie just under the rails. Patent 1590235. M. V. Gearon, 745 Cass St., Chicago, Ill.

PROTECTIVE DEVICE FOR RAILWAY CROSSINGS.—Whereby a train approaching the track crossing will automatically sound an alarm and close a gate, and passing the crossing will open the gate. Patent 1593521. J. K. West, Detroit, Minn.

SLACK ADJUSTER FOR AIR BRAKES.—By incorporating in the piston and plunger of a brake cylinder, means for periodically adjusting the brake shoes in respect to the wheels. Patent 1592909. W. S. DeCamp, 381 E. 2nd St., Chillicothe, Ohio.

RAIL-TIE PLATER.—A machine for applying tie plates to ties, and for properly positioning the ties on the base and under the tie plater device. Patent 1593423. R. A. Bradley, 24 Canal St., Merritton, Ontario, Canada.

Pertaining to Recreation

BATTING PRACTICE CAGE.—For outdoor baseball practice, the device is intended to reduce the number of balls fouled into the stands and lost. Patent 1591753. F. K. Flaugh, Herald Tribune, 225 W. 40th St., New York, N. Y.

ICE SKATE.—Including a removable and reversible runner which permits of ready and effective sharpening, and maintaining a better condition of the blade. Patent 1591,778. J. Radus, 784 Cassidy Ave., Hazzard, Pa.

LAND AND WATER TOY.—Including a figure simulating an oarsman, and having propelling mechanism serving to give a rowing movement to the figure. Patent 1591749. J. L. Duggan, 214 Elizabeth Ave., Elizabeth, N. J.

GAME APPARATUS.—Which affords means for the playing of a game which embodies in well balanced proportions the elements of skill and luck. Patent 1593421. J. Blum, 350 Corlies Ave., Pelham, N. Y.

TOY.—In which a spring motor is adapted to drive a mechanism for causing an alternating upward and downward movement to a figure. Patent 1594104. J. T. Miller, 302 E. 7th St., Clovis, N. M.

Pertaining to Vehicles

HEADLIGHT INDICATOR.—An attachment which will reflect back to the driver and will indicate whether or not the headlight lamp is lighted. Patent 1590047. A. F. Kammritz, 482 Franklin Ave., Hartford, Conn.

HYDRAULIC STEERING APPARATUS FOR TRACTORS.—So arranged that the motors of the respective treads can be run at different speeds in steering, instead of stopping one motor entirely. Patent 1590226. C. L. Boisset, 436 Girod St., New Orleans, La.

LOCKING DEVICE FOR IGNITION SWITCHES.—Easily applied to the ordinary construction of ignition switch without any changes, and without tools, effectually preventing operation by unauthorized persons. Patent 1590081. F. Lockyer, c/o Ideal Lock Mfg. Co., P. O. Box 33, Salt Lake City, Utah.

WAGON LOADER.—Adapted to be incorporated as a unit on any form of tractor for carrying movable arms to be oscillated for lifting a load. Patent 1591635. O. G. Mandt, c/o Mandt Construction Equipment Corp., Keokuk, Iowa.

AUTOMOBILE JACK.—Capable of being readily connected to the felly of a wheel for causing the wheel to be elevated upon rotation. Patent 1591731. J. T. Amiss, c/o Knox & Amiss, Baton Rouge, La.

GLARE CURTAIN.—To be applied to the windshield of an automobile to prevent the glare from automobiles approaching from the opposite direction. Patent 1591739. D. B. D. Blake, 112 Richmond Ave., Dayton, Ohio.

NONPNEUMATIC RESILIENT TIRE.—In which the parts are capable of ready removal or application whereby worn parts may be easily replaced. Patent 1591745. R. Curry, 540 E. 183rd St., New York, N. Y.

TIRE RIM.—Having stationary and removable flanges at the opposite sides, the removable flange consisting of circumferentially spaced radially projecting locking fingers. Patent 1591819. F. Hayward, 85 Woodhaven Ave., Elmhurst, N. Y.

SIGNALING WINDOW FOR AUTOMOBILES.—For vehicles of the closed type, by means of which the usual hand signals, required by law, may be effected without opening the regular window. Patent 1591786. J. Sharkey, 189 Montague St., Brooklyn, N. Y.

DRAIN VALVE.—Which may be employed in the drain opening of a crank case, the exterior parts being protected against damage. Patent 1591859. M. A. McCue, 146 Morris Ave., Long Branch, N. J.

TRANSMISSION GEAR.—Of few elements, readily thrown into position to produce a plurality of forward speeds and reverse. Patent 1591784. G. Q. Seaman, c/o J. S. Cunningham, 109 Hancock St., Brooklyn, N. Y.

TRAILER HOIST AND COUPLER.—For readily raising and lowering the front end of the trailer and for causing a ready connection and disconnection with the tractor. Patent 1591857. W. Mayer, 47 Gown St., Forest Hills, N. Y.

SHOCK ABSORBER.—For use on automobiles, which includes a novel form of oil seal for the joints between the relatively movable elements. Patent 1590565. F. A. Dowler, 1727 San Antonio Ave., Alameda, Calif.

DIRECTION INDICATOR.—In the form of a light hinged arm, adapted to be manipulated from the driver's seat, for indicating his intention to change direction or speed. Patent 1590648. J. M. and C. H. Quigley, 614 "S" St., Sacramento, Calif.

AUTOMATIC STARTER CONTROL AND NON-STALL DEVICE.—For automobile engines, which automatically throws in the starter of the engine as soon as the engine tends to stop. Patent 1592763. J. P. Geraghty, 481 Grove St., Jersey City, N. J.

BEARING.—For bicycles, motor-cycles, etc., which insures an effective lubrication of axle, shaft, bolt pin or other journal element. Patent 1593474. G. Serrao, c/o Attilio Serrao, 88 Cumberland St., Brooklyn, N. Y.

LOCKING DEVICE FOR AUTOMOBILES.—Having means for obstructing the movement of the controlling levers, preventing the car being towed or moved under its own power. Patent 1593815. A. Anson, 3206 53rd St., S.E., Portland, Oregon.

SPRING EQUALIZER.—Which consists of a lever mechanism allowing the spring end to play up and down as well as laterally. Patent 1593007. C. C. Goodrich, 639 Turk St., San Francisco, Calif.

SILVERED GLOBE AND ITS MOUNTING.—An incandescent bulb constructed to direct the rays from a headlight upon the roadway and to intercept certain rays causing objectionable glare. Patent 1594245. J. G. Davis, c/o L. L. Thalheimer, 1408½ Camp St., Dallas, Texas.

COMPRESSED-AIR AUTOMOBILE STARTER.—Having means for restoring the pressure of air in the tank immediately after carrying out a starting operation. Patent 1593810. F. M. Vermillion, Shattuck, Okla.

Designs

DESIGN FOR A SHOE.—Patent 70216. T. Davis, c/o Franklin, Simon & Co., 38th St. and 5th Ave., New York, N. Y.

DESIGN FOR A WOVEN FABRIC OR SIMILAR ARTICLE.—Patents 70462 and 70463. The inventor has been granted two patents of a similar nature. L. Bluhm, c/o Phoenix Mfg. Co., 40 Thomas St., New York, N. Y.

DESIGN FOR A SANDWICH TRAY.—Patents 70478, 70479, 70480, and 70481. The inventor has been granted four patents of a similar nature. O. Kopal, c/o Rowland & Marcellus, 130 5th Ave., New York, N. Y.

DESIGN FOR HOSE.—Patent 70506. J. L. McGarity, 418 Peters Bldg., Atlanta, Ga.

DESIGN FOR A SLIPPER ORNAMENT.—Patent 70572. Sara Myers, 27 Montgomery St., Gloversville, N. Y.

DESIGN FOR A NOVELTY CAT.—Patent 70,570. C. C. Moore, 226 W. 50th St., New York, N. Y.

DESIGN FOR A CHAIR OR THE LIKE.—The inventor has been granted two patents of a similar nature. Patents 70595 and 70596. M. Colt, c/o Gothic Shop, New Hope, Pa.

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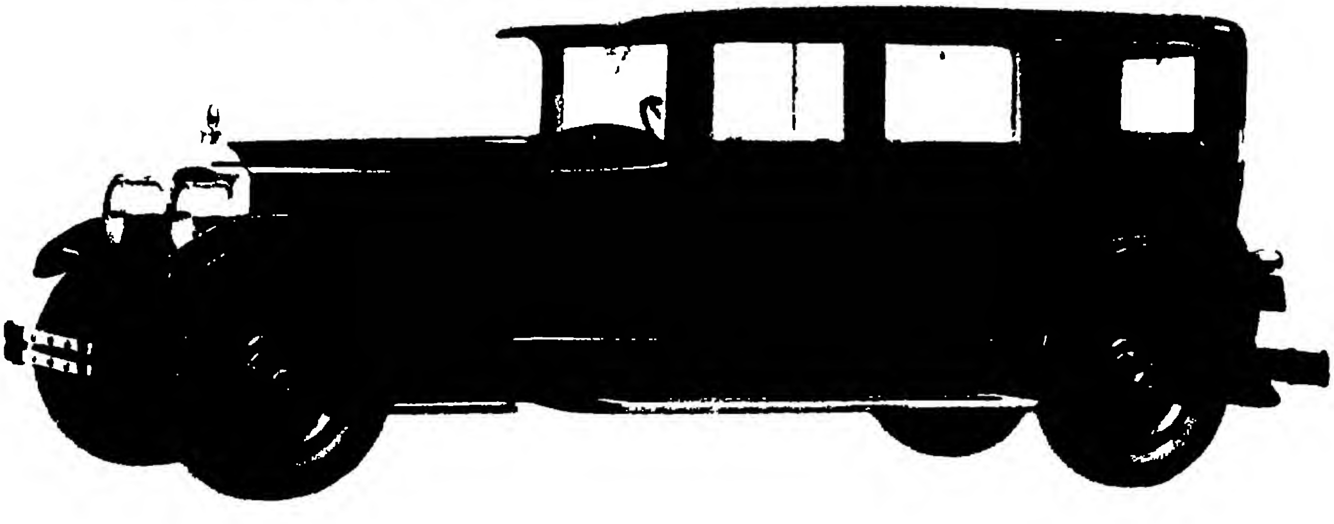

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SCIENTIFIC AMERICAN

THE TREATY CRUISER
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WHO WERE THE FIRST AMERICANS?
RADIO STYLES FOR 1926-1927

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SCIENTIFIC AMERICAN

THE MAGAZINE OF TODAY AND TOMORROW

NEW YORK, NOVEMBER, 1926 — *Edited by* ORSON D MUNN — EIGHTY-SECOND YEAR

ANNOUNCEMENT

BEGINNING with next month's issue, the Scientific American will include a department devoted to medicine It will be a regular monthly page like those we have published on astronomy during the last 26 years It will be prepared by Dr. Morris Fishbein, Editor of the famed *Journal of the American Medical Association* and of the popular journal *Hygeia* For a long time we have wanted something of this sort—straightforward, non technical, *authentic* To get it was another question

More and more the magazines—and even the newspapers—are full of much-heralded medical discoveries—cures for cancer, tuberculosis, what not One and all, we have long refused absolutely to publish these, for too often they give false hope to real sufferers and thus cause added anguish.

Dr Fishbein, it is hoped, will not only write about medicine and surgery, but he may attempt to assess the significance of some of the current cures, thus providing the hopeful patient with that which the usual announcement seldom provides him—a really conservative basis on which to judge them.

Our readers are honored by Dr. Fishbein's consent thus to serve them.

"AIRGRICULTURE"

ARMY Air Headquarters in Hawaii report cooperation with the Hawaiian Board of Agriculture and Forestry in sowing tree seeds by airplane on forest reserve lands which had been devastated by fire Two amphibian planes, working in an area of four square miles, distributed a total of 24 bags of seeds. It is estimated that in an hour and a half flying time two men accomplished as much as two men working on the ground could have done in ten years.

COSTLY

THE Scientific American moved out of the highest building in the world—the 57-story Woolworth Building—just in time, for Detroit is planning a higher one—the Book Building. It is to be eighty stories high! Thus, New York loses the lead in skyscrapers. Well, what of it! For a period of years, skyscrapers were a great advertisement Then they became too commonplace to thrill a blasé world Moreover, 900-foot buildings are not the most profitable, any more than 900 foot steamers are. In both cases, it is the largest that attracts the most notice but the medium sized that attracts the most money. Let Detroit have her fun and her thrill Sour grapes? Perhaps a trifle, but ours are crocodile tears. New York is planning a building still higher!

In This Issue

The Navy's New Cruiser
When the world's diplomats convened at Washington two years ago they laid down conditions which virtually forced the great powers into building a standardized cruiser A well known naval expert now says that these cruisers are the "unwanted offspring of a diplomatic compromise" On page 327 the same expert says other things too, equally poignant.

Making Atoms Confess
When a lawyer wants to reveal the inmost thoughts of the witness he endeavors to get him excited So with the physicist when he gets an atom "excited," it tells all sorts of things on itself This month, commencing on page 330, Prof K T Compton, noted physicist, explains some of the atom's inner workings under excitation.

Which One Is Right?
In the July issue a noted anthropologist, Dr. Ales Hrdlicka, virtually denied that man had been long in America This month another scientist, Harold J. Cook, takes strong issue with him, claiming that there is evidence that man has been in America for hundreds of thousands of years. Read pages 334 to 336.

How Much Dust In the Air?
Now that man has learned to fly he finds a need to know just how many dust particles a given volume of air contains. Some remarkably interesting work has been and is being done along this line See page 346.

MORE THAN 200 PICTURES

Complete table of contents will be found on page 400.

For Next Month

The Smallest Lamp In the World
Not the tiniest electric bulb, but the luminous bacteria which appear on fish or meat and in other unusual places—these are much the smallest lamps in the world. They are intensely interesting For one thing their overall efficiency is about 100 percent, while that of an electric lamp, only 3 percent! In the December issue Prof E. Newton Harvey will tell of them.

The Remarkable New Cathode-Ray Tube
Dr. William D Coolidge, noted Assistant Director of the research laboratories of the General Electric Company, recently announced a cathode ray tube far more powerful than any previously known Its significance is likely to prove immense. Next month, some of its striking effects will be described.

Physics of the Golf Ball
In the August issue Dr Sheldon explained some of the short comings of the golf ball We knew when this article was published that it would arouse controversy among golf enthusiasts It has! In the next issue a golf expert will answer some of the questions which the previous author raised

Other articles on The American Toy Industry, The Chimes of Catalina Island, The Scientific Reduction of Garbage, A Herd of Unique Hybrids; Snow Crystal Marvels, Rabbit Skins in the Manufacture of Furs, Out of the Inkwell, Manners and Customs of Ancient Egyptians; Astronomy, Radio.

MORE THAN 200 PICTURES

TRANSMUTATION

WHEN the German, Dr Miethe, announced that he had successfully transmuted mercury into gold he may be said to have "started something" For, ever since, numerous scientists have duplicated or paralleled his attempts with varying degrees of success or failure Every time a scientist has announced that transmutation in his own hands has proved a success, another scientist has announced just as vigorously that in *his* hands it was a failure.

The Scientific American tests, conducted by our Corresponding Editor, Prof H H Sheldon resulted in a demonstration that transmutation could not be effected by the methods employed Now comes a British scientist, Dr Milan W. Garrett of Oxford University, and tries the same experiment, duplicating the methods of Miethe Result: failure—no transmutation

Every time an announcement of this sort is made we feel a little more certain that Professor Sheldon was right.

HISTORY

ORGANIZATION of history as a science on a world wide scale has begun with the announcement of the American Historical Association that a permanent international committee has been formed. A congress of scholars specializing in the historical sciences will meet in Oslo in 1928.

The organizers of the movement believe the new movement will free historical scholarship from the national prejudices and inhibitions of boundary lines, and that the friendly cooperation of scholars from all countries will react favorably on all intellectuals in all countries and through them on politicians and the people

If we accept the simple definition, "science is classified knowledge," why should not history be an exact science? Too long has history been a matter of literature and imaginative literature, at that If only the nations can agree on the facts we will have gone a long way to making war unlikely

SORRY

FEW indeed of us enjoy having our name misquoted If our name is John Brown and someone addresses us as "James Browne" we feel irritated If the newspaper spells our name wrong we feel we have legitimate grounds to commit murder

We have just discovered that we misquoted the name of Roy Waldo Miner, author of "A Trip to the Bottom of the Sea," published in our August issue His name is not "Ralph" Waldo Miner as we printed it We hasten to make amends. We are sorry.

THE sponsors of Navy Day have sought to establish at least one day in each year when the people of the country will turn their thoughts in a special way to the mission, needs and activities of our first line of defense

The United States Navy of 1926 is not externally the infant Navy which challenged and successfully defeated the Barbary corsairs nearly a century and a half ago. Yet the same courage, fortitude and indomitable will so characteristic of our earliest sea commanders has wrought a wonderful transformation in the last one hundred and fifty years Proceeding slowly for a time our small fleet of sailing vessels, manned by daring pioneers with improvised armament, has evolved into the majestic fleet of today In 1775 Jeremiah O'Brien and his followers fought one of our first sea battles with a main armament consisting of pitchforks and farming implements It is a far cry from the crude method of warfare to the great aircraft carriers and battleships that today constitute the backbone of our Navy


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Slowly, painfully for a time, our Navy worked out its destiny There were no hasty and irretrievable steps The Navy's leaders have ever been men with broad vision keeping abreast of changing conditions, following the signs of the times, forecasting the future, their judgment tempered by the lessons of the past There have been no cataclysmic changes in the country's seapower Our Navy after years of experimentation grew out of sail into steam, from the vulnerable side wheeler it proceeded to the protected screw propeller, wooden ships became ironclads until exhaustive tests conclusively demonstrated the all steel vessels of today In the electrical era through which we are now passing our Navy has been the pioneer in the electric drive, the cast iron guns firing round shot a few hundred yards have surrendered to the steel rifled guns with cylindrical shells weighing nearly a ton and carrying a large charge of high explosive for many miles, the signal flag and semaphore are now assisted by the far reaching radio, to the ship of the sea have been added its allies, the vessel of the air and the hidden craft of the deep In 1776 our Navy proceeded on the surface at eleven knots Today it almost equals that speed underneath the waters, triples it on the surface and multiplies it many times in the sky above

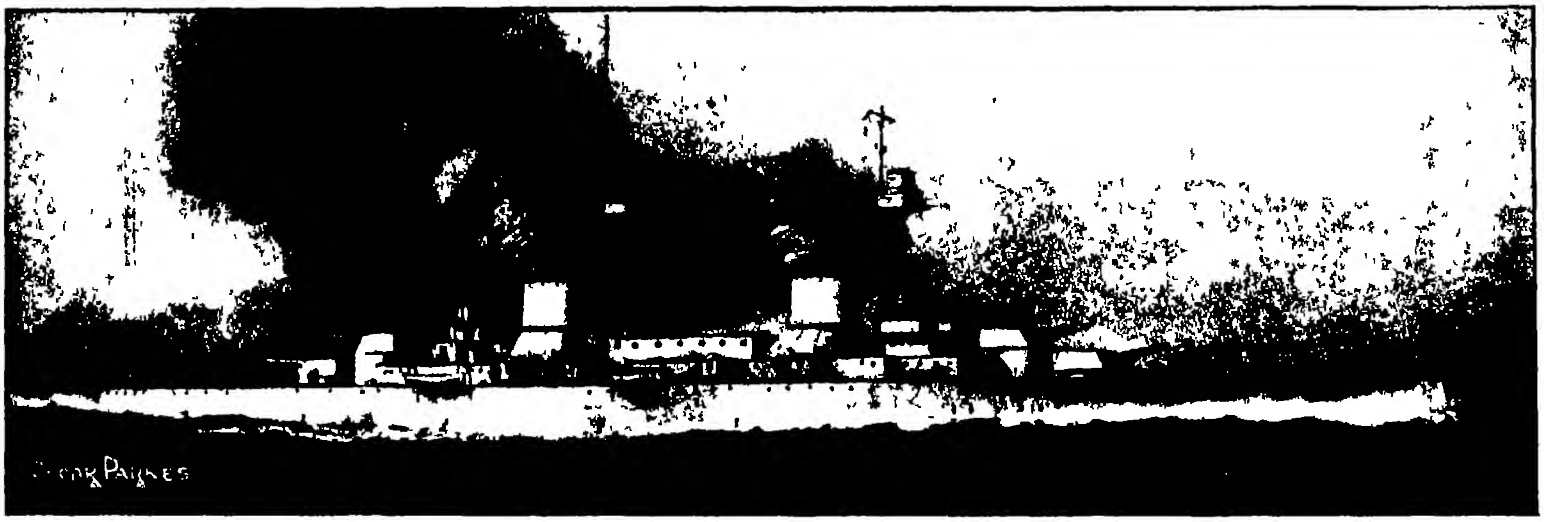
In its progress the Navy personnel has played an important role And the country at large has benefited by the pioneering spirit of the Navy man—scientifically, industrially and commercially By fostering, encouraging, and assisting manufacturers our Navy's experimental work in radio alone has contributed greatly to the welfare of the American people The educational advantages of this development can hardly be overestimated

Ceaseless progress, unflagging determination have been the keynote of the Navy's attitude Ships changed with the years but the resolute spirits of Jones, Decatur and Bainbridge have been perpetuated in their followers The nation will be glad to know that the progressive spirit is still dominant in the personnel of its first line of defense and will agree with President Coolidge when he said

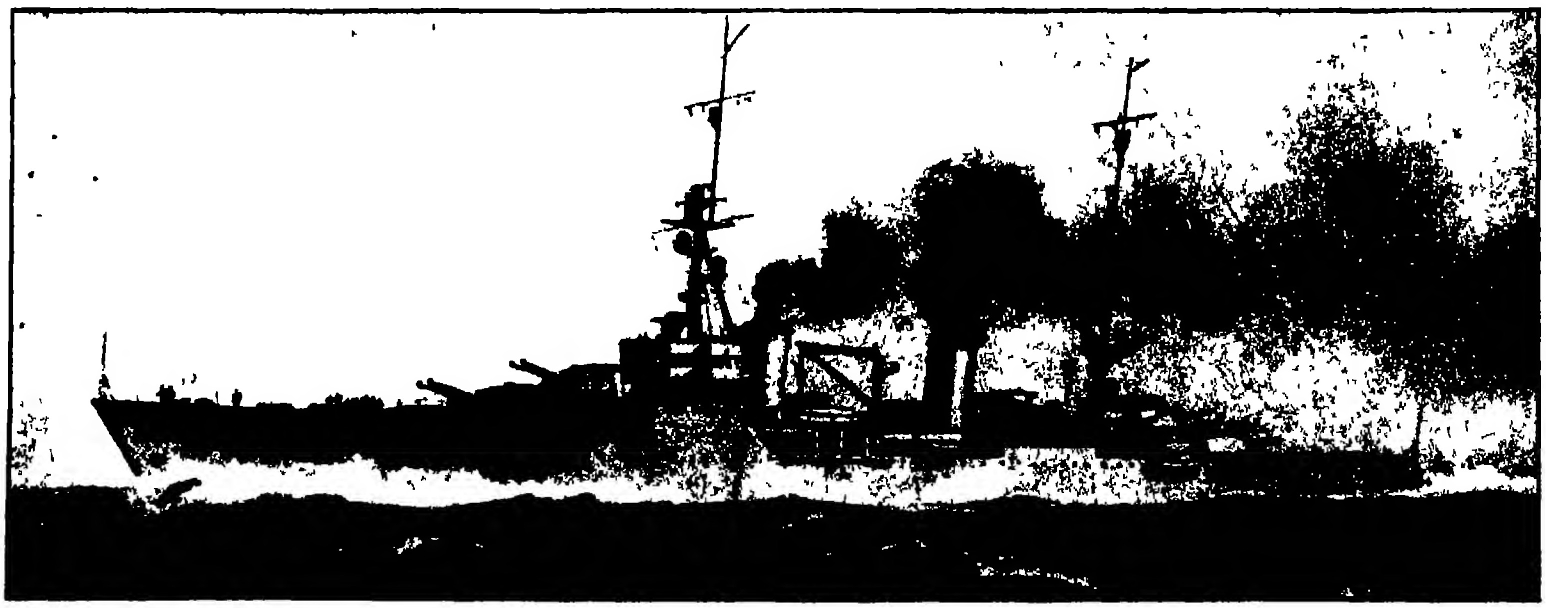
"Our American Navy has always been much more than an arm of wartime defense All the money that has ever been spent on the Navy has been returned to the community several times over in direct stimulus to industrial development We may be very sure that in the future as in the past, the Navy's services to industry and the arts of peace and science will continue completely to justify its maintenance in the highest efficiency"

Curtis D. Wilbur

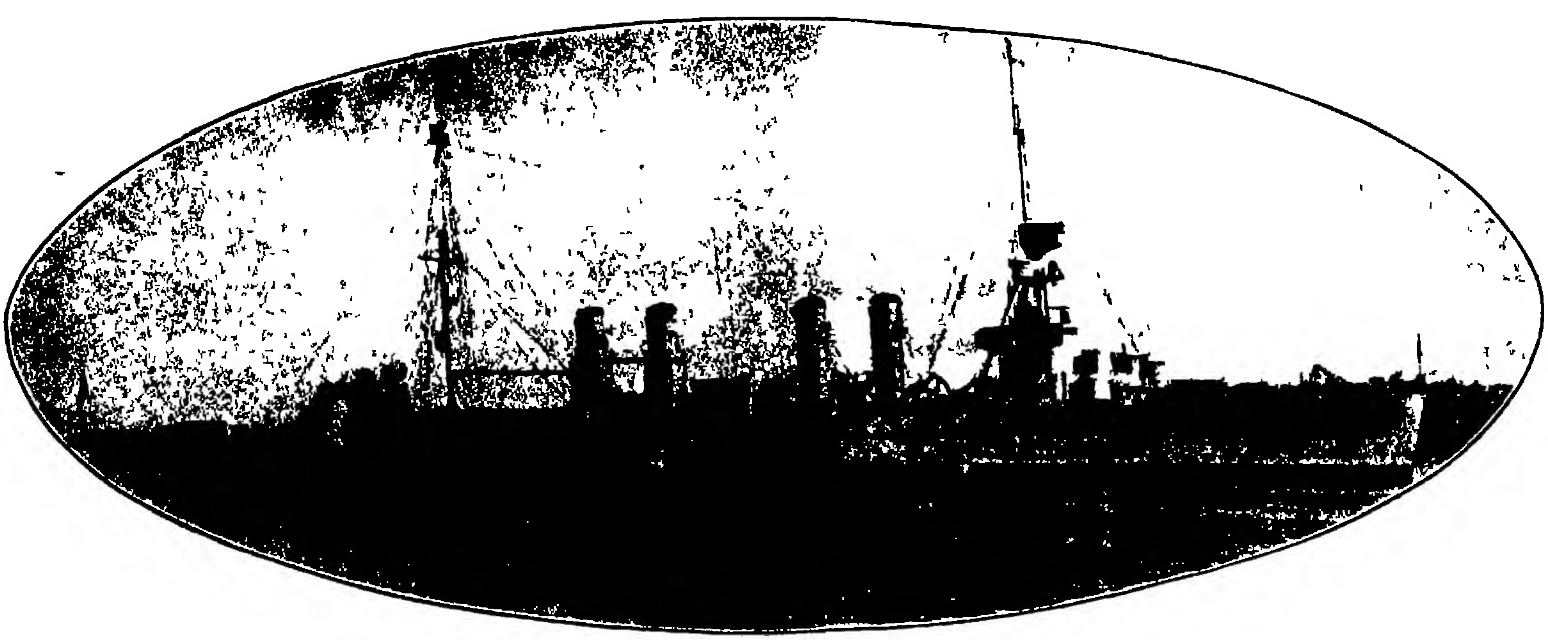
British Treaty cruiser, *Suffolk*. Speed, 34 knots. The standard displacement as set by the Washington Treaty is 10,000 tons, but this does not include any fuel or reserve feed-water, which will add another 1,500 tons. This will bring all Treaty cruisers up to 11,500 tons



Italian Treaty cruiser, *Trento*. Standard displacement, 10,000 tons; full load, 11,500 tons; length over all, 624 feet; beam, 67½ feet; mean draft, 19 feet. Guns: eight 50-caliber, eight-inch; twelve four-inch anti-aircraft Eight 21-inch torpedo tubes in twin mountings. Speed, 35 knots



French Treaty cruiser, *Tourville* Standard displacement, 10,000 tons. Length over all, 630 feet; beam, 63 feet; draft, 20 feet. Guns: eight eight-inch; eight 2.9-inch anti-aircraft; eight three-pounder anti-aircraft. Six 21.7-inch torpedo tubes in two triple mountings. Speed, 34 knots



UNITED STATES PRE-TREATY CRUISER "OMAHA"
Displacement as completed, 9,000 tons Speed, 34 knots The Treaty cruisers will be 10,000 tons displacement, with a speed of 31 knots

The Treaty Cruiser—Is It Worth While?

High Speed and Heavy Battery Offset By Poor Protection

By Hector C Bywater

THE standardized cruiser which the Washington Naval Treaty has brought into being is a ship nominally of 10,000 tons, but displacing at least 11,500 tons with fuel and feed water on board, having a speed not less than 33 knots, and a main battery of eight-inch guns. Vessels of this type are now under construction for all the major navies of the world. The British program comprises 16 such ships, the United States proposes to build eight; Japan has four on the stocks, France, three, and Italy, two. Twenty two cruisers of the treaty type are actually under construction, and many more will be laid down in the next few years, if current building plans mature These figures seem to suggest that the type is favored by international naval opinion. The facts, however, point to the contrary The treaty cruiser is being developed, not because of its inherent qualities as a fighting ship, but because circumstances have made it the recognized standard of cruiser power which no leading navy can ignore

Practical naval students are alive to its defects, hence the nicknames of "suicide ships" and "tinclads" which have been applied by some critics in England to the cruisers now being built there. The treaty cruiser is, in fact, the unwanted offspring of a diplomatic compromise. Certain American writers declare that British opposition at the Washington Conference to the scrapping of the "Raleigh" class cruisers, of 9,750 tons, resulted in the permissible displacement of future cruisers being raised to 10,000 tons, which was far above the average displacement of cruising ships then in existence. Moreover, since the "Raleighs" were armed with 7½ inch guns, the maximum gun caliber of future cruisers was fixed at eight inches. This story has never been confirmed, but it does offer a plausible explanation as to the strange action of the Conference in adopting such generous limits of tonnage and gun-power for future cruisers. It is, in any event, a singular fact that an international conference, convened for the purpose of limiting naval armament in every way possible, should have promoted the building of ships that are larger, more powerful and more expensive than the vessels of their type which were previously afloat

The British "Raleighs," having been designed for the special service of hunting German raiders, were provided with a battery of unusual strength to enable them to deal swiftly and decisively with such enemies, and they were further endowed with a great radius of action Hence their relatively large displacement However, of the 18 new British cruisers that were laid down subsequent to the "Raleighs," three were of 7,100 tons, and all the others of 4,190 to 4,700 tons Contemporary Japanese cruisers ranged from 3,500 to 5,600 tons Hence the *average* displacement of cruisers in the pre Conference period was not above 6,000 tons

In deciding to increase this average by 4,000 tons, the Conference experts can hardly have foreseen the consequences of their act The maximum tonnage limit has inevitably become, in practice, the minimum, for as soon as one power started to build 10,000-ton cruisers, the other powers were compelled, in self defense, to follow suit As a result, scores of ships that would ordinarily have remained effective for years to come, have been prematurely rendered obsolete, while the cost of cruiser construction has risen by at least 33 percent Nor is this all

Treaty Cruiser Not Adequately Armored

Previous to the Conference there were only 25 cruisers being built, ten of these being American, nine Japanese and six British—the latter representing the residue of war-time programs. Since the Conference, however, no fewer than 49 new cruisers have been laid down and authorized Of these, 15 are British, 12, Japanese; nine, French, eight, American, and five, Italian In the face of these figures it is impossible to deny that the Washington Treaty has tended to swell the volume of new cruiser construction instead of diminishing it Since 36 of the 49 post-Treaty ships are of the 10,000-ton class, it is evident that this class will predominate

The "standard" displacement specified in the Treaty is misleading, in that it does not include any fuel or reserve feed-water, two items which together may account for 1,500 tons Hence the true weight of a Treaty cruiser as ready for sea is likely to be 11,500 tons, a figure approaching the displacement of many a pre dreadnaught battleship But, whereas, the old mixed caliber battleship carried a large amount of defensive armor, the Treaty cruiser is signally deficient in this very important attribute of protection Admiral von Tirpitz who inspired the design of the German battle cruisers present at Jutland, used to say that the first requirement of a warship was that it should remain afloat and keep its fighting equipment intact to the last moment This principle was certainly embodied in all the German ships built during his administration Such units as the *Goeben*, the *Seydlitz* and the *Derfflinger* came within measureable distance of the ideal of unsinkability In the British battle cruisers, on the other hand, hull protection had been sacrificed to speed and gun power No impartial student of the Battle of Jutland can doubt which of the rival theories vindicated itself in that engagement.

In the case of the Treaty cruiser, the naval designer is up against a baffling problem He is asked, first of all, to provide for a speed of at least 33 knots, which entails great length and the installation of a very high powered steam plant He must further allow for a battery of not less than eight eight inch, 20 ton guns, besides an adequate number of anti aircraft pieces and torpedo tubes Space and weight must also be reserved for a large fuel supply, and for the accommodation of some 800 officers and men Even if the actual displacement of the ship be taken as 11,500 tons, it follows that, after all these requirements have been met, a very slender margin will be left for protective devices Even a partial waterline belt of armor thick enough to resist shot of medium caliber will be out of the question The ideal protection for such a ship would be a vaulted deck completely enclosing all the interior spaces and having a thickness of four inches over such vital parts as machinery and magazine spaces but the weight would, of course, be prohibitive

SPANISH PRE-TREATY CRUISER "PRINCIPE ALFONSO"
Normal displacement 7,850 tons; full load 9,000 tons; Speed 33 knots; Armor 1½ to three inch on sides, one to 1½ inch on decks

Probably the best that can be done is to work in thin horizontal plating on the waterline amidships, associated with light steel decks over the magazines, boilers and engines; but even at its strongest point this defense would be penetrable by the six-inch gun at medium range and by the eight-inch gun up to extreme fighting distance. It would, however, serve the purpose of discouraging the use of the large-capacity high-explosive shell.

The Treaty cruiser would still have insufficient protection even if the ships it had to meet in battle were armed with six-inch guns. But it must be prepared to encounter adversaries which are armed like itself with the eight-inch gun, a weapon discharging 260-pound shells with a velocity of 3,000 foot-seconds and a muzzle energy almost thrice that of the six-inch piece. It has an effective range of at least 18,000 yards. The latest Elswick eight-inch 50-caliber model is credited with a firing rate of five rounds a minute, but in stress of action four rounds a minute per gun from twin-mounted guns probably represents the highest rate attainable. A Treaty cruiser should thus be able to discharge 32 eight-inch shells a minute, making a total weight of 8,320 pounds.

The artillery power of these ships is indeed extremely formidable, a fact that brings into sharper contrast their shortcomings in the matter of protection. The average battleship, though presenting a big target, is able to endure a great deal of hammering without being placed *hors de combat*, because her vital parts are behind stout armor, and projectiles that hit her in other places would be unlikely to inflict fatal injury. But the Treaty cruiser is in a very different category.

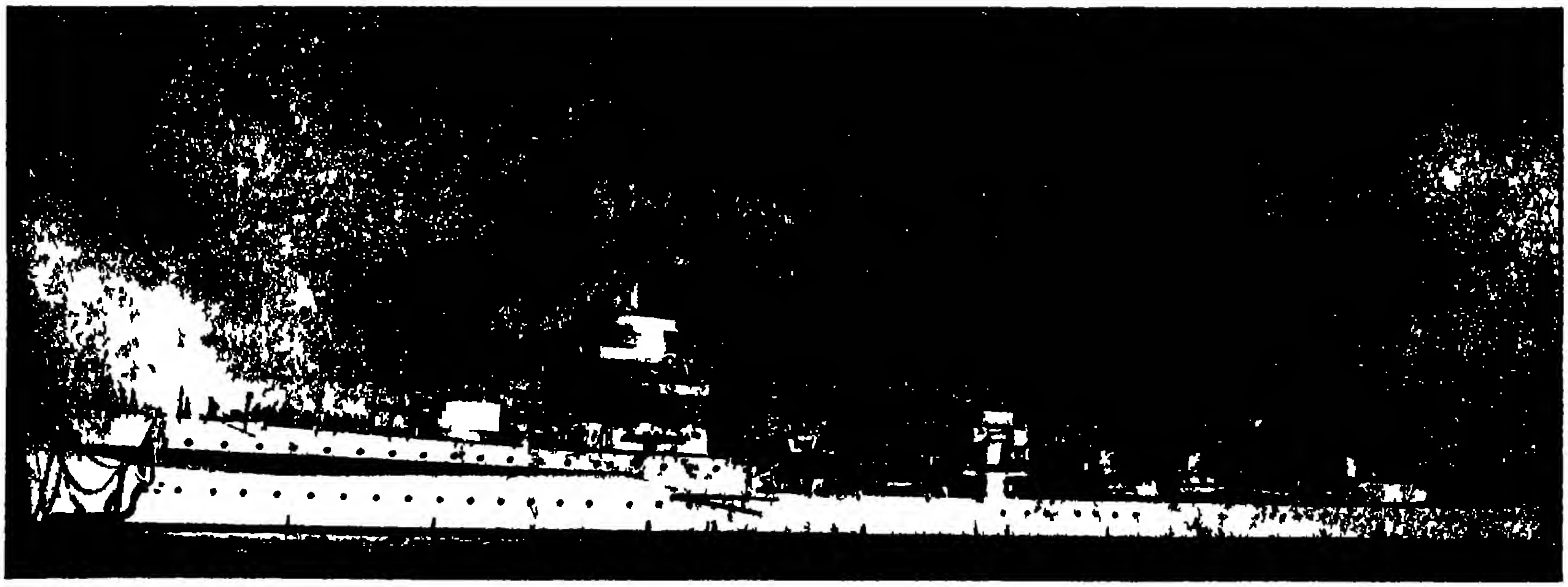
Diagrams of the French *Duquesne*, a typical ship of this class, show that more than four-fifths of the total length of hull is crowded with magazines and machinery. Therefore a projectile striking the hull anywhere save at the bow or stern would be liable to cause severe and possibly fatal injury. The *Duquesne* herself is reported as having 1½-inch armor on the sides and the same thickness on the gun turrets. It is doubtful whether this plating would be proof against the splinters of an eight-inch shell; it is utterly useless as protection against direct hits even from smaller caliber guns.

Vulnerability to Torpedo Attacks

As for the underwater protection of Treaty cruisers, the opinion of Sir George Thurston, a well-known British designer, may be quoted. Writing last year in Brassey's Naval Annual, he said: "The interior of such a cruiser is so fully occupied by boilers, machinery and magazines that it is not humanly possible to provide by bulkheads, water-tight compartments or other methods of underwater protection immunity from torpedo or mine attack. Therefore while in the interest of ordinary safety it is advisable to keep the vitals as far away as possible from the sides and to sub-divide to the fullest possible extent, it must be recognized that the explosion of a large mine or of a torpedo with a powerful warhead would, in the majority of cases, utterly wreck and destroy the vessel."

Every ship of war is exposed to the risk of destruction, but hitherto it has always been the practice, in vessels of major tonnage, to minimize this risk by allotting a substantial percentage of the total displacement to protective devices. This policy is a wise one from every point of view. A fighting ship that cannot survive a reasonable share of punishment is not worth her cost. It is difficult to escape the conclusion that the design of the Treaty cruiser is fundamentally wrong. These ships are simply speed machines, vulnerable to a degree unprecedented, and with the tactical advantage of powerful armament neutralized by inability to resist a single well-placed salvo. Yet each will cost from 12,500,000 to 15,000,000 dollars, and—what is of infinitely greater moment—the lives of 800 men will be involved in the fate of the vessel.

The Treaty cruiser is, in effect, a hybrid type, brought into existence under abnormal circumstances. Here, surely, is one section of the Naval Treaty that stands in urgent need of revision. It should be one of the aims of the next disarmament conference to limit the displacement of future non-capital ships to 7,000 tons or less and their armament to six-inch guns.



BRITISH PRE-TREATY CRUISER "ENTERPRISE"
Normal displacement 7,600 tons; full load 8,800 tons; Length over all, 570 feet; Speed, 33 knots; Side armor 1½ to three-inch, decks one-inch

A DEMONSTRATION MODEL OF THE PARACHUTE

This illustration serves to depict the relationship between the parachute and the airplane which it supports, particularly as to the fastening between them

P & A Photo

THE PARACHUTE OPENING IN MID AIR

Dropping at an estimated rate of 38 feet per second, the airplane was brought to earth safely by means of the parachute shown in the act of opening

P & A Photo

JUST AFTER A SUCCESSFUL LANDING

Although the under-carriage was said to be slightly damaged in the initial test, all concerned expressed their hopes for the ultimate success of the device

P & A Photo

THE PLANE, THE PARACHUTE AND THE PILOT

This photograph shows the parachute piled on the fuselage after what is said to be the first successful landing of a plane by means of a parachute

Parachute Carries Airplane to Earth

The first landing of a plane, supported by a parachute, ever made in the United States, was reported recently. The pilot, R. Carl Oelze of the San Diego Naval Air Station shut off his motor at 2,500 feet altitude but, it is said, made no attempt at gliding. The plane landed in one minute and six seconds after falling at an average speed of 38 feet per second. The descent appeared rapid at first, but was checked as the parachute opened. The plane then swung from side to side, but as it approached the earth its descent became steadier. The plane and parachute settled to earth in a slight hollow, suffering some damage to the landing gear. The final speed at which the plane landed was estimated to be considerably less than the average speed. The application of the parachute to the support of the entire plane is the joint invention of Harry B. Doucett, Chief Aviation Machinist's Mate at the San Diego Naval Air Station and of H. R. Russell, maker of the so-called Russell parachute. Lieutenant P. D. Donnelly, also of the San Diego Air Station, predicted that the tests would lead to the design of aircraft in which the passenger compartment would be detachable, so that in the event of serious accident in the air, the pilot would be able to deliver the whole compartment safely to earth. In the experiment described, plane, pilot and equipment weighed about 1,800 pounds. The parachute weighed about sixty pounds and was 54 feet in diameter. The plane used in the test was specially rebuilt to strengthen the midship section of the fuselage which would receive the greatest strain as the parachute opened. The parachute was installed in such a manner in the fuselage that it could readily be disengaged by the pilot. It was designed to be carried back by the wind, then opened and swung upward by the air pressure until it occupied the position shown in the photograph of the model. A special cradle of steel and aluminum was built into heavy center wing struts. The size of the parachute was determined from previous experience, to give a landing speed of not more than twenty feet per second. As an extra precaution the landing gear was strengthened to withstand an unexpectedly severe landing shock. The experiment is undoubtedly interesting, but it cannot be said to be conclusive. In the most dangerous aerial difficulties, such as when the plane stalls a short distance from the ground and goes into a spin, there would be no time to use the parachute. At greater altitudes it is much simpler for the pilot and crew to jump in individual parachutes. But for commercial craft carrying several passengers unversed in parachute jumping the development is not without interest. We may expect to hear more of this device in the future.

The Excited States of Atoms

By Karl T. Compton
Professor of Physics, Princeton University

MANY of us who count ourselves still young remember the definition in our text books of chemistry, "Atoms are the indivisible constituents of matter" It is said that a young student, who had boldly suggested a possible subdivision of atoms to explain some phenomenon and was sharply reminded by Lord Kelvin that the very word atom is the Greek for indivisible, replied, 'There you see the disadvantage of knowing Greek"

We now know that every atom is a complex structure, consisting of a positive electrical charge of known amount and a definite number of negatively charged electrons arranged around the positive charge, and probably moving in orbits like planets around a sun

Another old and rather deeply rooted idea is that an atom is an entity, possessing always the same definite specific properties. This concept, like that of the indivisible atom, has had to be discarded We now know that every atom is capable of existing in an infinitely infinite variety of states which may differ markedly in chemical and physical properties.

A well established method of investigating any object is to stir it up and then see what happens In dealing with atoms, which cannot be seen, this is the only available method of examination All our knowledge about atoms has come through the finding of a consistent line of interpretation of what happens when matter (a complex structure of atoms) is disturbed in various ways. Only a few of the simpler and more striking effects of such disturbance can be discussed in this brief space.

Most fruitful of all methods of studying atoms has been the examination of the light which they emit under various stimuli, together with the con verse study of the kinds of light which they can absorb under various conditions

Light passing through a slit may be brought to a focus by a lens, so as to cast an image of the slit on a screen If a transparent prism is interposed, the light rays are bent, different colors or wavelengths of light being bent differently, so that there are as many separate images of the slit cast on the screen as there are different colors of light in the source If all wavelengths are present, as in light from an incandescent solid, these images merge into one another, side by side, and the result is the familiar continuous or rainbow spectrum. But if the source of light is a luminous gas, then only light of certain definite wavelengths is found to be present and there is a corresponding set of images of the slit, each in its own color and in a position on the screen which depends upon its wavelength. This set of colored images is the "spectrum" of the gas. If the screen is a photographic plate, the arrangement described above is a spectrograph—capable of giving a permanent photographic record of the spectrum

The spectrum of a gas is an extraordinarily definite thing, absolutely characteristic of each particular gas Some spectra are very simple, others are very complicated. Figure 1 (a) shows the simplest spectrum, that of hydrogen, and shows that the spectrum which the eye can see is only a small part of the entire spectrum which can be investigated photographically, or by other methods. Figure 1 (b) shows a small section of one of the most complex spectra, that of iron vapor

The remarkable definiteness of the spectrum of each kind of atom at once suggests something very definite in the structure or behavior of the atom These "somethings" are the "states" of the atom, and experiments of the sort to be described later show that light is emitted or absorbed by the atom only as it changes its internal structure from some one of these states to another. This can be illustrated by the so-called "Grotrian" diagram of hydrogen, Figure 2.

The heavy horizontal dashes represent the possible states of a hydrogen atom and the vertical position, or level, is proportional to the energy contained by the atom in these states The state of least energy, which we can take as the zero energy state, is the "normal" state of the atom, that is, the state in which all hydrogen atoms are found unless some source of energy is acting to increase their energy to that of the other states, which are called the 'excited" states. The differences between these states are known to be due to differences in the arrangement of the electrons which exist outside the nucleus, probably in the shape and size of their elliptical orbits In a hydrogen atom there is only one electron, so that each of these states corresponds to some one of the possible orbits of this electron In the normal state this orbit is very small, the electron remaining always close to the nucleus (about one hundred millionth of a centimeter from it).

The states of larger energy correspond to larger orbits, and the increased energy is due to the work done in pulling the electron to a greater distance from the attracting nucleus. The dotted line at the top is the state in which the orbit is so large that the electron flies away and is lost to the atom The most striking feature of the atom is the existence of these discrete states or orbits, instead of all varieties of orbits as are possible in gravitational motions.

Every change of an atom from a state of higher to a state of lower energy is accompanied by the emission of light whose vibration frequency (the reciprocal of the wavelength) is directly proportional to the difference in energy of the two states Thus, if W_2 and W_1 are the energies of the two states, the change from state 2 to state 1 gives rise to the emission of light of frequency ν given by $W_2 - W_1 = h\nu$ where h is known as Planck's constant. Thus we see that in changing its state, an atom radiates in the form of light the energy which it loses in the change. If it changes from a low to a higher energy state, the corresponding amount of light energy of the right frequency must be absorbed from the agency which causes the change.

With this explanation, it may be seen to be pos-

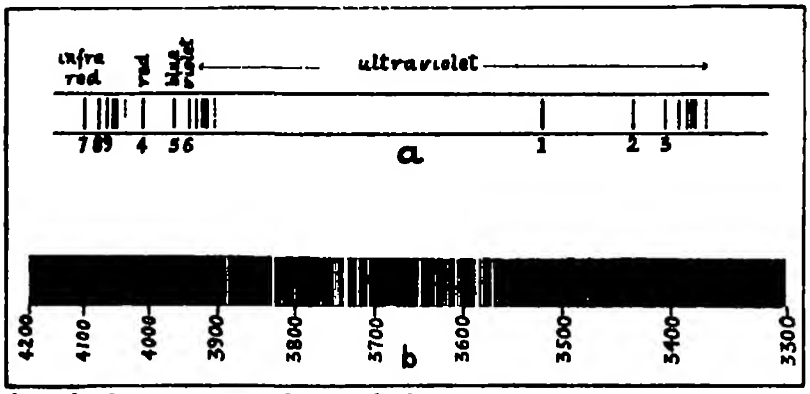
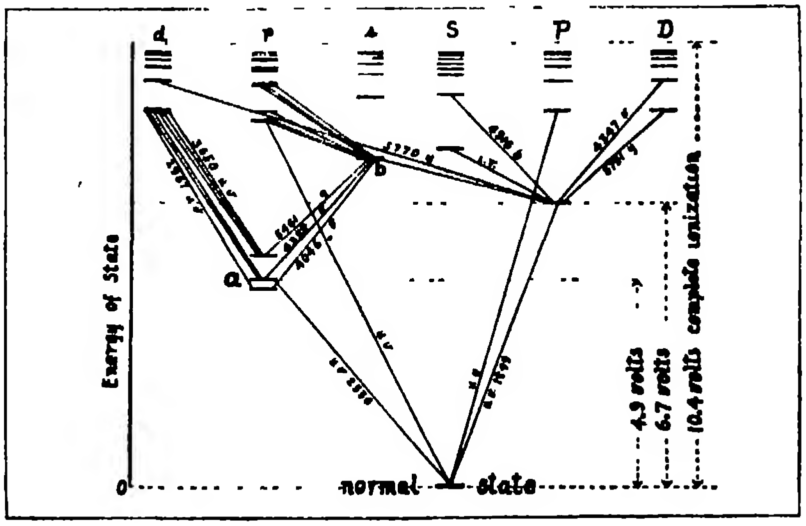


FIGURE 1

ABOVE (a) *Diagram of spectrum of hydrogen showing series of lines 1, 2, 3, et cetera, in ultraviolet, series 4, 5, 6, et cetera, in the visible and near ultraviolet, and series 7, 8, 9 et cetera, in infra red The distances from the left are proportional to light vibration frequencies Figure 1 (b) Portion of the spectrum of iron The numbers are wave lengths in units of 0.00000001 centimeter The extreme left end of the spectrum lies in the violet end of visible region*

FIGURE 3

BELOW: *Grotrian diagram of energy states of mercury Diagonal lines show transitions between states which produce prominent lines in mercury spectrum Letters y, g, b, et cetera, indicate color, numbers indicate wavelengths*



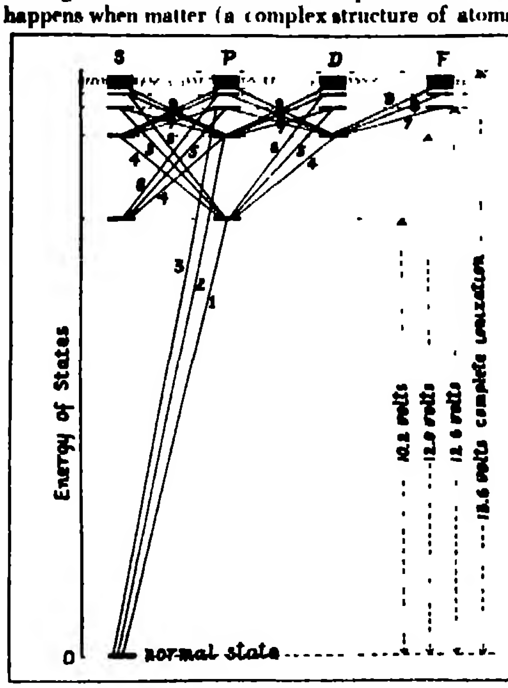


FIGURE 2

Grotrian diagram of the energy states of hydrogen

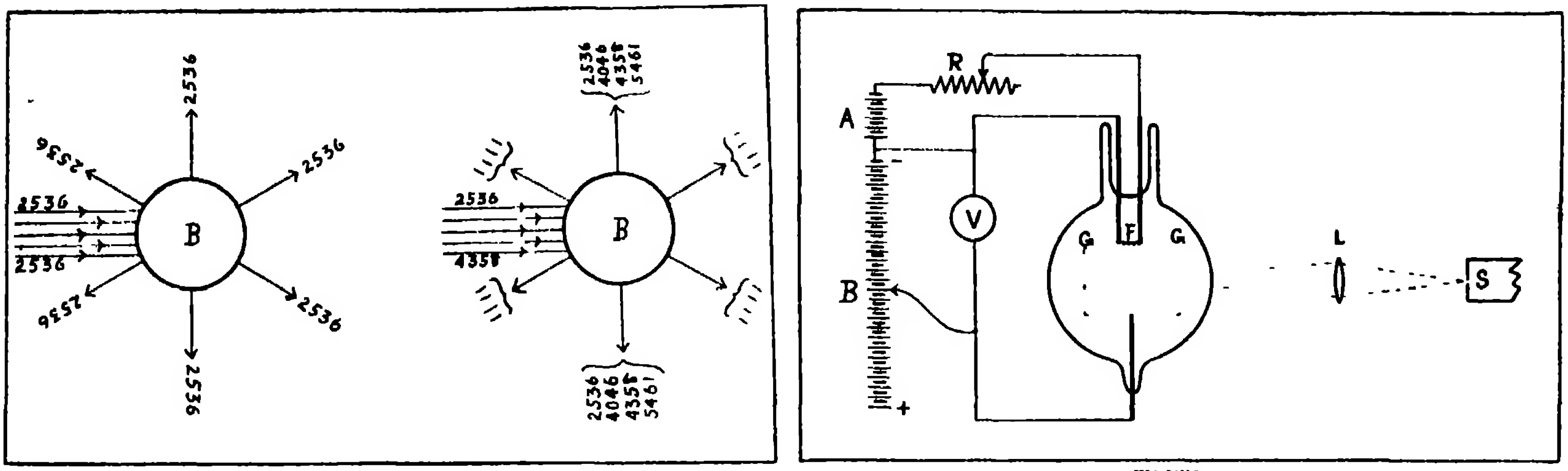


FIGURE 4

FIGURE 5

sible to unravel a complicated spectrum so as to find out just what energy states must be assumed to exist in the atom in order to account for the observed spectrum For instance, the spectral lines marked 1, 2, 3, 4—in Figure 1 (a) are due to transitions between energy states as indicated by the correspondingly numbered diagonal lines in Figure 2 The notation S, P, D, F, et cetera, has a significance which is most simply stated by saying that, usually, only those changes of state occur which are between adjacent columns, that is, from S to P, D to P, P to D, et cetera, but not S to F, et cetera.

Figure 3 shows a portion of the similar Grotrian diagram of the states of mercury, with a few of the changes of state which produce the prominent lines in the mercury arc spectrum designated by y, g, b, u v, and so on, according to the color or ultraviolet character of the light emitted in the change. The numbers correspond to wavelengths of the light in units of one hundred millionth of a centimeter.

Atoms Absorb and Reradiate Light

We now pass to another phase of investigation by which the validity of this energy state explanation of spectra has been placed on a direct experimental basis. From among numerous types of experiment, two of the simplest and most significant are the following

(1) *Optical Excitation* (Figure 4.) Ordinary mercury vapor, for example, can only absorb light of wavelengths corresponding to transitions from the normal state, as shown by the various spectral lines in the series 1, 2, 3, et cetera, and 4, 5, 6, et cetera, in Figure 3 To all other light the normal vapor is transparent Suppose that a bulb containing mercury vapor is placed in a beam of ultra violet 2536 light (that is, light having a wavelength of 2536 ten millionths of a millimeter or Angstrom units), coming from any convenient source such as a nearby mercury arc. Some of the mercury atoms, in absorbing this light, are "excited" to the state *a*, whence they sooner or later revert to the normal state and re-emit the 2536 light Thus the mercury vapor absorbs 2536 light and reradiates it in all directions. This reradiated light, called "resonance radiation," has been extensively investigated by R W Wood.

If mercury vapor is illuminated by violet light 4358 nothing happens, since the mercury atoms in the normal state cannot absorb it But if illuminated *simultaneously* by 4358 and 2536, *then* there is emitted by the vapor light of the four wavelengths 5461, 4358, 4046 and 2536 as a result of the following process: first, mercury atoms are excited to state *a* by absorbing 2536 light, second, these atoms now in state *a* are able to absorb 4358 light and some of them will do so, yielding excited atoms of state *b*. From states *a* and *b*, there are possible the transitions to lower energy states which emit the four spectral lines mentioned above In a similar way the various energy states may be optically excited, *one by one, and the Grotrian diagram verified step by step*

(2) *Excitation by Electron Impact* Another way of supplying energy in definite amounts to atoms is to bombard them by electrons whose kinetic energy is controlled in the following manner

In a glass or quartz bulb a filament F is heated to incandescence by current from a battery A, and in this condition it emits electrons which are drawn to a perforated gauze G by applying between F and G a voltage V from a battery B Many electrons pass through the openings in the gauze and collide with atoms of gas If the voltage V is large enough, this bombardment suffices to change the atoms from their normal to their various excited states, and in returning to their normal states they emit a spectrum, which serves to identify the states to which they have been changed by the bombardment This spectrum is examined by concentrating the light

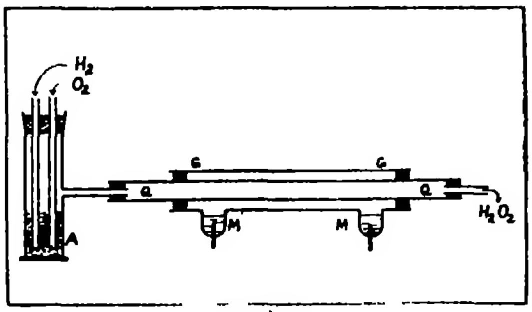


FIGURE 6

which is produced on the slit of a spectrograph, by means of a lens L

The experimental procedure is to increase the bombarding voltage V in small steps, and examine the spectrum at each step In case the bulb contains mercury vapor, for example, no light at all is produced by the bombardment if V is less than 4.9 volts At this voltage the line 2536 appears in the spectrum, but no other line appears (except faintly, due to complicating phenomena) until the voltage is increased to 6 7 volts, at which the line 1849 appears Similarly the other lines appear one by one as the voltage is raised until, at 10 4 volts, the entire arc spectrum is present

Now the kinetic energy of an electron which has moved through 4.9 volts, is easily calculated, and when this is divided by Planck's constant *h* we have exactly the frequency corresponding to 2536 light Similar calculations give the other lines of the mercury spectrum, and some of these are indicated to the right in Figure 3 Thus we have made a direct measure of the energies of the various states of mercury and verified the energy state diagram which was suggested to interpret the spectrum Similar studies of other gases and vapors have been made.

A series of brilliant investigations, principally by Franck and his pupils in Gottingen, has disclosed the fact that the energy stored up in excited atoms may be used in other ways than to produce light, and this discovery will doubtless have wide applications in chemistry and in the art of illumination A single illustration, taken from work done in Princeton by Professor Taylor and his collaborators, will serve to suggest the possibilities of this discovery in chemistry

It is well known that hydrogen, H_2, and oxygen O_2, when mixed, do not combine unless ignited, and then they combine with explosive violence to form water, H_2O But they may be otherwise united through the agency of excited atoms as follows

In Figure 6, QQ is a quartz tube A glass tube GG is provided with mercury electrodes MM and evacuated. Oxygen and hydrogen gases are made to stream through the quartz tube and a mercury arc is maintained in the surrounding tube Although the oxygen and hydrogen in the quartz tube are intensely illuminated by light from the mercury arc, they are unaffected thereby since they are transparent to those wavelengths of light supplied by the mercury arc, and thus absorb no energy from it

What Is Photocatalysis?

If, however, the oxygen and hydrogen are bubbled through mercury, as at A, so that they carry along with them a little mercury vapor into the quartz tube, the gases emerge combined in the form of hydrogen peroxide, H_2O_2 The action is this the mercury atoms within the quartz tube absorb the 2536 light from the mercury arc and are changed to the excited state *a* Figure 3 If a mercury atom while in this excited state collides with a hydrogen molecule, its energy may be transferred to the molecule and is sufficient to split this molecule into two separate atoms In this atomic state the hydrogen atoms are able spontaneously to start the reaction which leads to the production of hydrogen peroxide The mercury vapor emerges from the reaction unchanged

This "photocatalytic" action is typical of many others, such as that of chlorophyll in leaves to render sunlight effective for plant growth and that of "sensitizers" in photographic work The discovery of the reason for these catalytic actions will doubtless expedite their applications to many useful purposes

It is realized that so brief a survey as this cannot be complete It is hoped only that it may serve to disclose one direction of recent research in this important branch of atomic physics and to suggest the point of view, the methods and the possible applications of this work

Our Point of View

Unjust Censure of the "S-51"

WE were filled with amazement and indignation on reading the findings of the Boston inspectors of the United States Steamboat Inspection Service on the sinking of the *S 51*, as recorded in the daily press Although the steamboat inspectors found that, as the result of her disobeying the rules of the road on the high seas, the *City of Rome* caused the loss of a navy ship and the death of thirty-three officers and men of the Navy, they imposed an amazingly slight penalty by suspending the captain and the mate of the law breaking ship for only nine months If the extent of the penalty is to be taken as a measure of the gravity of the offense, these steamboat inspectors cannot blame the public if it believes that they have a very slight regard for the sanctity of the International Rules of the Road on the high seas.

This is bad enough, but when these gentlemen proceed to cast a slur upon the ill fated officers of the ship who were sent so summarily to their death, they are insulting the Navy of the United States and are doing grave dishonor to heroic men who died in the faithful performance of duty Just listen to this

"We are satisfied," say the inspectors, "that had the officers on the *S-51* been under the jurisdiction of this service, action would have been taken against their license had it been possible" There is a suggestion of spite and a very strong flavor of gross impertinence in this statement Whatever the steamboat inspectors may think of the International Rules, the officers on any Court Martial or Court of Inquiry held in our Navy have and always will have for these rules a most profound regard. And judged by these rules, not only was the navigation of the *S 51* absolutely correct, but if she had changed her course or in any way maneuvered to avoid the *City of Rome*, as the steamboat inspectors suggest she should have done, her officers would have been guilty of a direct breach of the law—as we shall now show

Article XIX of the International Rules reads "When two steam vessels are crossing, so as to involve the risk of collision, the vessel which has the other on her own starboard side," in this case the *City of Rome*, "shall keep out of the way of the other"

Article XXI "When by any of these rules one of two vessels is to keep out of the way, the other," in this the *S 51*, "shall keep her course and speed"

When the ship which is obeying the rules sees that the ship which is breaking them is coming so close that the risk of collision is great, then and only then is she justified in not keeping "her course and speed" When the *S 51* saw that the *City of Rome* was making collision imminent, she endeavored to turn away, for when she was raised her rudder was found to be swung over to starboard

The International Rules of the Road are based upon centuries of experience, and they constitute one of the greatest safeguards to life at sea If the Steamboat Inspection Service of Boston takes upon itself to suggest that the navigating officers of ships should do anything else but most rigidly observe these rules, we think it is about time that this local steamboat inspection service be itself subjected to very drastic inspection

Six Years' Oil Supply Left

THE preliminary report to President Coolidge of the Federal Oil Conservation Board, recently made public, says that in the proved oil sands of the United States there is sufficient oil to keep the United States going for only six years. Hence the Board emphasizes very strongly the need for taking immediate measures for oil conservation

In creating the Board, the President called in four members of his Cabinet namely, Secretaries Work, Hoover, Davis and Wilbur, representing respectively the Departments of the Interior, Commerce, Labor and the Navy A more authoritative Board could not exist, but in order to give to its findings the highest industrial and financial authority, invitations were sent to the large producing, refining and marketing companies of the country, who gave full cooperation in securing the required data Moreover, some of the most expert engineers, geologists and owners read papers at the various meetings of the Board, that showed an evident desire to bring out all the facts and make a frank statement of opinion Hence the report, which is signed by the four cabinet members above mentioned, is a document of the very highest authority In these days of propaganda, it is refreshing to receive a document dealing with a great national problem, whose statements may be accepted without a shadow of a doubt as to their truth and impartiality

The findings are fully in keeping with the facts which the Scientific American has brought out, during the past few months, in its articles on the oil industry The report states that the total present reserves in pumping and flowing wells is estimated at 4,500,000,000 barrels But in spite of this vast reserve, it is estimated that, theoretically, the supply of oil cannot be estimated to meet the demand of the United States for more than six consecutive years

Perhaps the most important part of the report is that which deals with unrestricted drilling and the great waste which attends it The facts which we unearthed in our own investigation of the problem are fully indorsed In some cases indeed they are exceeded, as for instance when we read that in the Cushing field in Oklahoma the waste of gas amounts to 300,000,000 cubic feet of natural gas per day or 100,000,000,000 cubic feet a year, which the report affirms is the equivalent of 5,500,000 tons of coal

The Board emphasizes the need of cooperative drilling, but it evidently considers that this should be done by mutual agreement among the leaders of the industry and not as the result of direct legislative action. With this policy we are in entire agreement, although it would be well for the oil industry to realize that unless unrestricted drilling is stopped, Congress, in sheer defense of one of the nation's most valuable war reserves, will be under the necessity of taking direct control by legislative enactment.

Maintain the Treaty Navy

There is one outstanding policy for the nation to follow with regard to the United States Navy, and that is to furnish sufficient appropriations to maintain the Navy in the rank assigned to it by the Treaty of Washington. This rank is determined by the formula "5-5-3" as applied to the three leading navies—our own, and those of Great Britain and Japan. Save for the annual outburst of our venerable friend, Rear Admiral Rodgers at the Williamstown gatherings, our naval officers have accepted the Washington ratio and are now bending their efforts to maintaining our Treaty Navy in a high state of efficiency. This is as it should be, and in connection with the Navy Day celebration they can do most valuable work by impressing upon our citizens that the Navy is our first arm of defense, and that so long as we maintain it on a par with that of Great Britain, both as regards material and personnel, our interests upon the high seas will be fully secured.

Alfred Ely Beach

SEPTEMBER the first of the present year marked the centennial of the birth of Alfred Ely Beach, who for nearly half a century was the editor of the Scientific American. Although he was but nineteen years old, young Beach was not without antecedents and experience in such literary work, for he was a nephew of Ben Day, the founder of the *New York Sun*, and was also the son of the second owner of that paper, furthermore he had seen a few years of active work on his father's staff

Young Beach's life opportunity came in 1846 when he learned that the Scientific American was for sale and he immediately wrote to his former schoolmate, Orson D. Munn, asking him to come to New York with such capital as he could furnish and share in the new and promising venture Young Munn acted quickly, for he at once gave up his job, married, and came to New York with his bride Thus was formed a partnership which lasted for fifty years The Scientific American, under the care of its young owners became the Mecca for inventors. Beach possessed a keenly inventive mind and was always ready to advise and assist gratuitously anyone who was working upon a promising device Hence Munn & Company were the early confidants, advisers and friends of some of America's most distinguished inventors. The writer has heard Mr Beach, in his later years, tell of one of Edison's visits to the office, when the inventor placed a small box provided with a crank upon the editorial desk. At Edison's request Beach turned the crank, when he was startled to hear a voice issue from the box exclaiming, "Good morning, sir, how are you?"

Mr Beach was himself a prolific inventor and among his own inventions, perfected when he was not yet of age, was a typewriter which embossed the letters on a paper tape for the blind to read.

Learning that the British Postmaster General was developing a scheme for transmitting the mails through pneumatic tubes, Mr Beach devised a tube and carrier which would not merely transmit mail, but would automatically collect it from the street letter boxes *en route* Then, in 1869, he obtained a charter to build such a tube from the Liberty Street Post Office to the Harlem River, but with the proviso that there must be no ripping up of the street This was never built, but to meet these conditions he devised a hydraulic tunneling shield and by its use he built a full-sized experimental tunnel beneath Broadway from Warren Street to Murray Street This tube remained in existence, though blocked up, until the construction of the B M. T. Subway a few years ago. These and other inventions of less importance show that, like Seldon, Mr. Beach was a pioneer inventor.

Mars Again Our Neighbor

Recent Photographic and Other Investigations With Instruments Instead of the Human Eye Confirm the Majority of the Conclusions of Lowell Concerning Mars

By Henry Norris Russell, Ph.D.
Professor of Astronomy, Princeton University
Research Associate of the Mt. Wilson Observatory of the Carnegie Institution

THE principal astronomical event of November this year is undoubtedly the opposition of Mars, which occurs on the fourth at 4 A M, Eastern Standard Time

All through this month, as through October, the planet will be the object of intensive studies of varied sorts, for the opportunity which the occasion affords is a good one Although not quite so close to the earth as in 1924, Mars is more favorably placed for northern observatories—being in Aries—and some 15 degrees north of the celestial equator. His distance, which at his closest approach on October 27th is 42,500,000 miles, increases gradually and, by the end of November, reaches 52,000,000 miles Even so, he is closer for almost the whole month than he ever comes at an average opposition This makes him a brilliant object His greatest brightness at the beginning of the month corresponds to the stellar magnitude −2 1, that is, he is of nearly twice the apparent brightness of Sirius and just about equal to Jupiter By the end of the month he has lost half his light, but he still exceeds all the stars, except Sirius. His northern declination makes him rise early—at 5 10 P M on the first, and more than two hours before this on the 30th, and he is visible practically all night.

With the telescope, Mars presents a disk which is fully 20 seconds in diameter at the month's beginning and nearly 17 seconds at its close With a magnifying power of 100, he looks larger than the full moon—although this would not be recognized by the novice, since objects seen directly in the sky impress the eye as being a good deal larger than those which, when viewed telescopically, are of equal angular subtense With good atmospheric conditions, considerable surface detail should be seen on a disk of this size even with telescopes of moderate dimensions.

New Light on Mars

The season on Mars during this month corresponds with February upon the earth—that is, the southern hemisphere is in the latter part of summer, so that the south polar cap—which alone is visible to us since the north pole is turned away from the earth—should be far advanced in its shrinkage and should appear as hardly more than a little white dot, if indeed it has not wholly vanished

Mars is the object of so much, so general and so reasonable an interest that it may be appropriate to review our present knowledge and our hopes for this year's observations, even though most of what is said here has been said before in these columns at various times.

For many years, the study of Mars proceeded mainly by means of visual observation of the details of its surface. These showed, more than 200 years ago, the seasonal changes of the white polar caps and the existence of permanent darkish and greenish areas mottling the planet's ruddy surface. The work of the last 50 years added the recognition of the faint, narrow and elusive "canals" (fine almost linear markings which cross both the light and dark areas), seasonal changes in the intensity and hue of some of the dark markings, and also led to the detection of occasional white spots lasting for a very few days at most, which strongly suggested clouds

The theory that the polar caps were snowfields, that the dark regions were areas of vegetation and that the canals were narrow plant covered areas in the reddish deserts, irrigated by water courses natural or artificial, gave a consistent account of these phenomena, but in spite of this, there was much scepticism about it, for no satisfactory proof of any part of it was forthcoming at a time when the eye was the only "instrument" employed

Within the last few years, however, the Martian problem has taken on quite a new aspect, for new and powerful methods of observation have been applied. Photography—with steadily increasing success as its technique improved—has obtained direct evidence, free from any question of personal equation, of the reality of the more prominent canals, the seasonal changes of the dark areas and the existence of occasional clouds The use of color sensitive plates with screens of different colors, has brought out a wealth of facts, not yet fully interpreted, which show that the contrast of the various features is greatest in red and least in violet light, and suggest strongly the existence of an atmosphere upon Mars, less in quantity than on the earth but still considerable

Animal Life May Exist

Still more striking are the radiometric observations, which not merely detect the heat which the planet sends us, but make it possible to obtain a fairly good estimate of the surface temperature Two independent groups of observers agree on the conclusion that the temperature at noon in the Martian tropics throughout the year and at the poles at the end of summer, rises well above the freezing point—probably to about 50 degrees, Fahrenheit—while at night, it must be far below freezing even on the equator

Finally, spectroscopic studies have given definite evidence that both oxygen and water vapor are present in the atmosphere of Mars—although in much smaller quantities than on the earth

This long series of important investigations speaks on the whole very strongly in favor of the theory of Martian conditions which was developed by visual observers. The determinations of temperature make it practically certain that the polar caps are really composed of frozen water—and not of some other chemical substance The spectroscopic observations confirm this, and the presence of oxygen makes it appear more likely than not that vegetation exists on the planet, for the existence of green plants which take up energy from sunlight, decompose carbon dioxide and liberate oxygen, appears to afford the best way of accounting for the presence of this chemically very active gas in the planet's atmosphere

Granting this, the great question of the existence of life on Mars is solved, for plants are just as much alive as animals.

Of the main points raised by such students as the late Dr Percival Lowell, the majority appear now to be well on the way toward settlement, in a manner favorable to his ideas. The most striking of all his conclusions—the sharply geometrical character of the network of canals, with Lowell's inference that they were the product of intelligent activity, remains unsettled The drawings of various observers appear to be affected by complicated personal equations which make the results curiously dissimilar, and unfortunately even the best photographs are not fine grained enough to reveal such delicate details on such small images as those of the planet must needs be

If vegetable life exists on the planet, as seems fairly probable, animal life may exist The latter could not do so otherwise But we appear to be far from having any unquestioned evidence that it does

Despite the great advances resulting from the Martian observations of 1924, much still remains to be done The radiometric observers—profiting by previous experience—should be able to tell us much regarding the way in which the planet's surface temperature varies during the course of the day, and with the progress of the seasons, and certain puzzling data obtained at the last opposition, which indicated a very low temperature of about −70 degrees Centigrade for the polar cap itself, may this time be explained

The photographic observations will carry their permanent record of the appearance and changes of the dark markings later into the Martian season than was possible two years ago The work with color screens bids fair to be especially interesting Professor Wright at the Lick Observatory, found in 1924 that the images of the planet obtained with violet light, were distinctly bigger than those photographed with red light—using a reflecting telescope, so that the two ought, theoretically, to have been of the same size

What the Astronomers Are Doing

Does this mean that Mars has an extensive atmosphere which reflects violet light but not red? Or is the difference of size a photographic effect, due to different properties of the various sorts of plates which were employed? This autumn's observations are going far towards settling the matter

When the planet has moved on and the thousands of color photographs of it have to be interpreted, more work will be in order—photographing terrestrial landscapes, preferably in arid regions to study the appearance of snow clouds, rocks and vegetation, when they are viewed through various thicknesses of air and photographed with the color screens used in observing Mars

The spectroscopists, too, will be busy repeating the tests for atmospheric oxygen and water vapor, and perhaps will seek to determine whether there is more of the latter close to the diminishing polar caps than after the snowfields have disappeared.

Finally, the visual observers will still be busy doing the kind of work they have previously done.

Here is a long programme of interesting work, and we may be assured that our knowledge of the planet will be materially advanced at this opposition It seems doubtful whether the remarkable advances of 1924 can be matched, but in any case, there ought to be things worth reporting—not next month, but in a year or so, when the task of reducing and discussing the observations comes to an end.

The Antiquity of Man in America

Who Were the First Americans? Whence Came They?

By Harold J Cook

IN the Scientific American for July 1926 appeared a splendid article by Dr Ales Hrdlicka anthropologist of the United States National Museum on The Race and Antiquity of the American Indian. It is probable that no one living is better qualified to discuss in detail the comparative racial and physical characteristics of the American Indian particularly with reference to the skull and brain.

It is but natural that a man's opinions should be influenced by his training and that his point of view should be correspondingly affected. But only when all types of competent evidence are properly weighed and evaluated can a comparatively true solution of the problem of the antiquity of man in America with a proper perspective be reached. It is not the intention in this article to introduce in any sense a controversial spirit but in fairness to other branches of science we must review both sides of the question.

In Dr Hrdlicka's interesting article we have considered from the anthropological angle man's antiquity in America. Let us now view some of the geological and paleontological evidence. Here is a great field of important data that is too sound and definite to be ignored. True all human remains so far found in America appear to have a general racial homogeneity and to lack radical differentiation. On the other hand we must not lightly discard evidence by which it appears that man in America antedates many previous calculations.

If we assume that because primitive Neanderthaloid or other races occurred in Europe in Pleistocene times we must find here a similar sequence in order to prove that man had reached America by glacial times we are presupposing conditions that no one yet knows. It is entirely possible that the Indians who have inhabited America have changed very little structurally and physically in many thousands of years. As any comparative anatomist familiar with the ancient life of the world knows many races of vertebrates have at times remained little changed through millions of years while through other long periods the rate of progressive change or evolution has been marked and rapid. Some branches of certain families have reached a given stage and then seemed structurally speaking satisfied to hold

HAROLD J COOK

The author of this article is honorary curator of paleontology at the Colorado Museum of Natural History

that condition with little alteration during periods when other branches of the family were undergoing radical changes. The evidence that this has occurred is well known to vertebrate paleontologists and it is not necessary to go into the possible and probable controlling factors. As a result we now know that we must not stress anatomical features to the exclusion of other lines of pertinent evidence for while valuable they are not in themselves conclusive. Unless there is an agreement it must follow that some evidence is not being properly interpreted.

Mere Facts May Spoil Good Theories

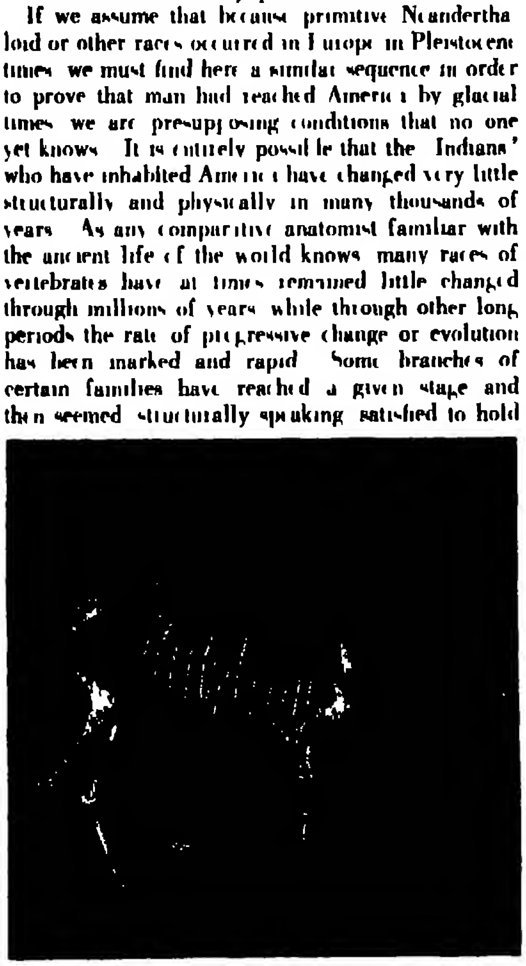
It seems probable that most if not all of our known American Indian stock has reached this country from or via Asia whatever their original abode. This has occurred at times when land conditions existed which were more propitious to such migrations than exist at this time. No one knows just what these land connections were save in a very general way. A slight emergence of the present Bering Straits region would suffice. Climatic factors have of course been active in influencing habitat and migrations in the past as they do at the present. One who is not familiar with geology cannot appreciate what tremendous and fundamental fluctuations of climate the earth has undergone. We have no reason to believe that such changes have ceased although generally their pulses run slowly judging by the evidence in the rocks. If we may question how man could have reached here during glacial times we may in the same breath and with equal propriety ask how the bison could have reached here in glacial times! Likewise other animals which we have good reason to believe are Asiatic migrants. If such animals could live and migrate so could nomadic man as is well demonstrated in recent times. There is much that we do not know about glacial and interglacial times, especially in great areas in America where the ice sheets did not extend and it is well not to be too certain and too dogmatic about what could and could not have been, until all available evidence is carefully weighed and studied.

From known evidence it appears extremely likely that in recent geologic times migrations from Asia into America of both animals and men have been in the nature of successive waves and in part, rather long drawn out dribbles instead of a single migration period. Consequently, among human migrants we would expect to find elements of various more or less related and unrelated Mongolian, Tartaric or other Asiatic stocks represented in America. It is well to recall that we have almost no "pure" human racial stocks, and particularly is this true on the major continents. With every possible degree of hybridism present elisions and physical characters and blending are the almost certain result. This seriously complicates the problems that face the anatomist who attempts to draw broad conclusions on anatomical evidence alone and makes results far less certain.

Dr Hrdlicka makes the statement that—"The Indian is free from characteristic odor." This is a mistake, as anyone with active olfactories familiar with the American Indian, knows. The Indian has a pronounced racial odor easily told from other races as the writer knows from lifelong personal contact with him. The odor is so pronounced that as early western army people or pioneers have frequently testified many army mules and horses would snort and become terrified when Indians were near and up wind from them but out of sight especially at night thus giving the alarm that Indians were about when not otherwise suspected. I, personally, have seen this and have repeatedly heard similar testimony from unquestionable sources. Likewise many early Indian horses would show great fear of a white man but pay no attention at all to Indians.

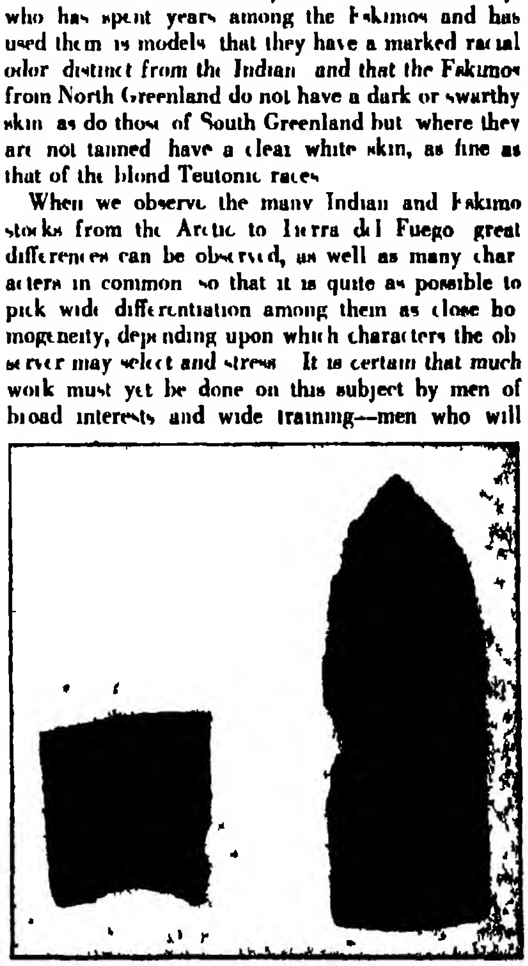
The writer is informed by a well known authority who has spent years among the Eskimos and has used them as models that they have a marked racial odor distinct from the Indian and that the Eskimos from North Greenland do not have a dark or swarthy skin as do those of South Greenland but where they are not tanned have a clear white skin, as fine as that of the blond Teutonic races.

When we observe the many Indian and Eskimo stocks from the Arctic to Tierra del Fuego great differences can be observed, as well as many characters in common so that it is quite as possible to pick wide differentiation among them as close homogeneity, depending upon which characters the observer may select and stress. It is certain that much work must yet be done on this subject by men of broad interests and wide training—men who will



WHERE THE EVIDENCE WAS FOUND

Stone lance points made by human hands were found with and under this bison skeleton discovered in solid rock of Pleistocene age. The specimen from Texas is on exhibition at the Colorado Museum of Natural History, Denver



EVIDENCE OF THE EARLY AMERICAN

These stone lance points or large arrow points were found buried in the under side of the bison in the undisturbed Pleistocene rock. The remarkably fine workmanship is much superior to the later cultures in the same region

approach its problems free from preconceived notions and who will weigh and evaluate all evidence found in all fields of research without bias.

It is not apparent to the writer that man, if he existed here in glacial times, would have been here perforce, in great numbers, as has been suggested. That is possible, or even probable, but is by no means to be taken for granted without proof. Certainly such a statement is without foundation as a basis of argument as to man's presence in America at that time, though it is an interesting conjecture. As to man's "traces on the road" in eastern Asia or northern and western America, it is well to remember that these great regions are hardly scratched even yet by the hand of the scientist who understands what he finds when he finds it. Splendid work, sure to show results, is at present in progress in both Asia and America, but even this is a small beginning in a great field.

Why Early Man Left So Little Evidence

To the untrained person, or the person trained only in one field, it is difficult to grasp the magnitude and breadth of the evidence that is yet to be found and studied, and when one considers the handful of living men who are really doing such work, the wonder is that we know what is now known, and not that we do not yet have in our card indexes a record of all the desirable evidence. Every year, fortunately, is adding to this wealth of accurate knowledge. It is the proper business of the true scientist to search out this evidence and to follow where it leads, not to try to prove or disprove theories—interesting and instructive as they may sometimes be as pets.

Owing to the character of most of the deposits of glacial age that are known in America, and given a nomadic people such as our modern plains Indians who built no permanent abodes, developed no marked shell or bone heaps and who buried their dead in trees, on scaffolds or under some cliff covered as a rule only by a few rocks or cacti (in any event in such a manner as to almost certainly preclude their preservation)—it would be surprising if we *did* find abundant evidence of such a race or any evidence at all without time and patience and good fortune. We would know little of their distribution or numbers, save for the evidence of bits of stone implements and the like. In the case of cliff dwellers, mound builders, pueblo builders, cave dwellers and their kind, it would of course be another matter. But even here we have by no means learned all there is to know of the antiquity of such people in America. Here again students of other lines of study beside anthropology will have to be called in to interpret properly and to understand much evidence that is available. Otherwise grave error is the certain result.

Some months ago a discovery of unusual interest was made in southwestern Texas which upon investigation proved to be of exceptional importance. It was a discovery which gives us definite and positive evidence of the presence of man in America in

> **The Realization of a Boyhood Dream**
>
> **There is a kind of romance in the unusual career of the author of the accompanying article. Early in the 70's his father, a former army scout, homesteaded a ranch along the Niobrara River in Wyoming, near the Nebraska line. On that ranch there was a quarry, now called "Agate Fossil Quarry." It contained an abundance of Tertiary Period fossils. These fired the mind of the rancher's son. In time, after much study, he qualified as a trained paleontologist. Not only has he contributed specimens to many large museums, but his recent discovery of the fossil tooth of an anthropoid ape of great antiquity made him well known among scientists. In his honor others gave his find the euphonious name of *Hesperopithecus haroldcookii*—Harold Cook's western ape.** ***The Editor***

Pleistocene or glacial times—evidence so definite and certain that no person familiar with such geology could question it. A general examination of the region showed that in late Tertiary times (before the Pleistocene or "glacial") the whole area in question was being eroded. It was a rather low rolling region cut by numerous relatively shallow valleys. Then due to one of the vicissitudes to which the region has been subjected, the pitch or gradient of the whole area was for a time altered. It became more level, so that when the Pleistocene deposits were being washed from the nearby higher Cretaceous and older rocks (the source of these sediments was determined) they were redeposited in these valleys which were cut down into Cretaceous and Triassic Age (Age of Reptiles) rocks. Thus the Tertiary valleys were refilled with Pleistocene muds, sands and gravels, and in so doing the remains of some of the animals of the time were naturally entombed. Later the general level of the region again tilted and the old valleys were recut and restored to approximately their old levels. In the process, however, remnants of the Pleistocene beds were left along the sides of the ancient valleys.

At the particular spot in question, near the little town of Colorado, Texas, the complete articulated skeleton of an extinct type of bison was found buried under some eighteen feet of these old gravels, undisturbed and solidly cemented. The present little stream, Lone Wolf Creek, had slowly cut its way down to the old valley floor here, and under the vertical wall of Pleistocene sands and gravels collectors from the Colorado Museum of Natural History, Denver, found a few bones weathering out just above the old valley floor. Following these by slowly and laboriously working back under the bank they came upon the whole skeleton. Bones of several other individuals of the same species were found to occur here and were collected simultaneously. But the important find came in taking out the complete skeleton. Lying close against and immediately along the under side of the neck was found a beautifully worked flint spear point! A second one of similar and equally fine workmanship was found along and under the thigh bone. A third was found in the body cavity, but this point disappeared in the field just after being found.

Ancient Bison, Ancient Flints, Ancient Man

Now finding stone arrows or spear points associated with a buffalo skeleton may not seem at first glance an especially important bit of evidence. But let us consider a few facts in this case. First, the buffalo is not like the living American bison. It is larger, has flattened horns quite unlike the living American family, and is much more like the Indian or Asiatic buffalo. Undoubtedly it is an Asiatic migrant into America. As yet undescribed and unnamed, it is waiting completion of comparative studies.

Continuing the search in these beds the bones of more of these buffalo were found and also the bones and teeth of several other extinct animals, including a very large camel, two species of mammoth, a large and a small species of primitive horse and a primitive deer. All of these species are of types closely comparable to species previously found in other parts of America in beds of known glacial times or Pleistocene Age. True, no one yet knows just how late some of these species may have survived in America. But on the other hand they are typical Pleistocene species, and it is certain that the evidence as to time is far more convincing and more probably certain when we consider the anatomical evidence in *several* families, all known to have been evolving rapidly, than that of merely *one*, that is, man—as considered by the anthropologists who take

TWO VIEWS OF LONE WOLF CREEK NEAR COLORADO, TEXAS, WHERE THE FOSSIL BUFFALO AND HUMAN IMPLEMENTS WERE DISCOVERED

The fossils were found in the rock of the bank just above the water level at the locality shown in the right-hand picture. A geological cross-sectional drawing showing the nature of the same strata and the valley filling, part of which has been eroded away, is shown on the next page

that altitude Beyond this, all conditions carefully observed and noted in the field pointed clearly to antiquity, and eliminated all doubts as to the Pleistocene age of these deposits

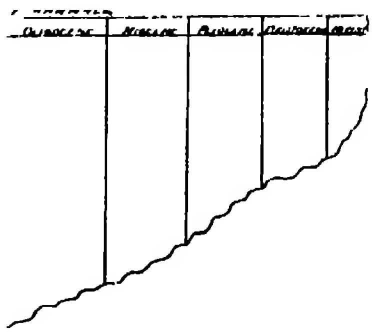
Now—consider the conditions, position and association as found The bones are typically fossilized but are so extremely fragile that they disintegrate almost completely upon exposure, unless uncovered very carefully and hardened at once by special toughening solutions, such as shellac It is utterly out of the question, as anyone familiar with such a deposit will know, that recutting at any relatively recent date, such as the time when Lone Wolf Creek cut down into these beds, could by any possibility have reached or disturbed that articulated skeleton under which the stone points were found, without disarticulating and destroying the skeleton The matrix is a dense, toughly cemented, sandy gravel, whose original layers are clearly visible, and in such a matrix no amount of time, with percolating, mineral bearing waters, could hide the evidence of artificial disturbance, such as man digging down

"We Intend to *Know*"

In other words, there can be no possible doubt that those lance points (or extra large arrow points) are as old as, and contemporaneous with, that buffalo

No matter what we call the time in which he lived, it was certainly a great many thousand years ago In this connection, it is interesting to note that the writer found two cultural levels or stages above this in that area, the lower and older of which, while comparatively more recent, is also prehistoric These people lived largely on a big species of fresh water mussel, now long extinct in that part of Texas One of the principal village sites was found on a small arroyo, or ravine, which at that time was evidently a running stream It is now about eighteen miles from living water The evidences of erosion which are present also indicate considerable antiquity These people lived here when southwestern Texas had a much wetter climate than it has today

Let us drop back and take a glance at some interesting geological evidence In the middle Miocene times, we begin to find evidence in America in rocks of that age (middle epoch of the "Age of Mammals") of the migration of Asiatic mammals into America, including the elephant At the close of this period, we find marked evidence of continental elevation and a very mild climate extending far to the north, so that the ensuing Lower Pliocene Age in America is one of exceptional richness and interest With the opening of the Pliocene, we find evidence of the



... OF THE LATER GEOLOGICAL EPOCHS
During these epochs the mammals, such as horses, rodents, bats, whales, man and so on, evolved into their present forms

migration of many kinds of land animals into America and, undoubtedly, many American stocks reached Asia at this time With a warm climate extending to Alaska, as evidence shows, and a connection there with Asia, due to temporary elevation of what are now sea bottom areas in the Bering Straits, we have every ideal condition for the entrance into America of many kinds of animals, including anthropoids or early man

That such stocks did enter America at this time we know through the finding of the much discussed *Hesperopithecus* from the Lower Pliocene beds near Agate, Nebraska, which antedates the classical *Pithecanthropus* found by Dr Eugene Dubois in the Pliocene of Java in 1891 1892 It may here be stated that further evidence of such Pliocene stocks is now known to its discoverers and is under study As yet we have found but the merest beginning of a start of the available evidence of Pliocene life in America This is because only a small handful of men have really worked on its problems The area and deposits to be examined will take centuries of time and many trained men So little monetary backing has been given by Americans for such scientific research that the results are consequently restricted A very few eager minded Americans of means have been responsible for most of the work done, aided by a handful of men who were willing to sacrifice personal gain to seek out the fascinating secrets of such buried ancient life Even our great National Museum, the widely known Smithsonian Institution, has such inadequate and niggardly financial backing from our Congress which maintains it, that its work is under a shameful handicap.

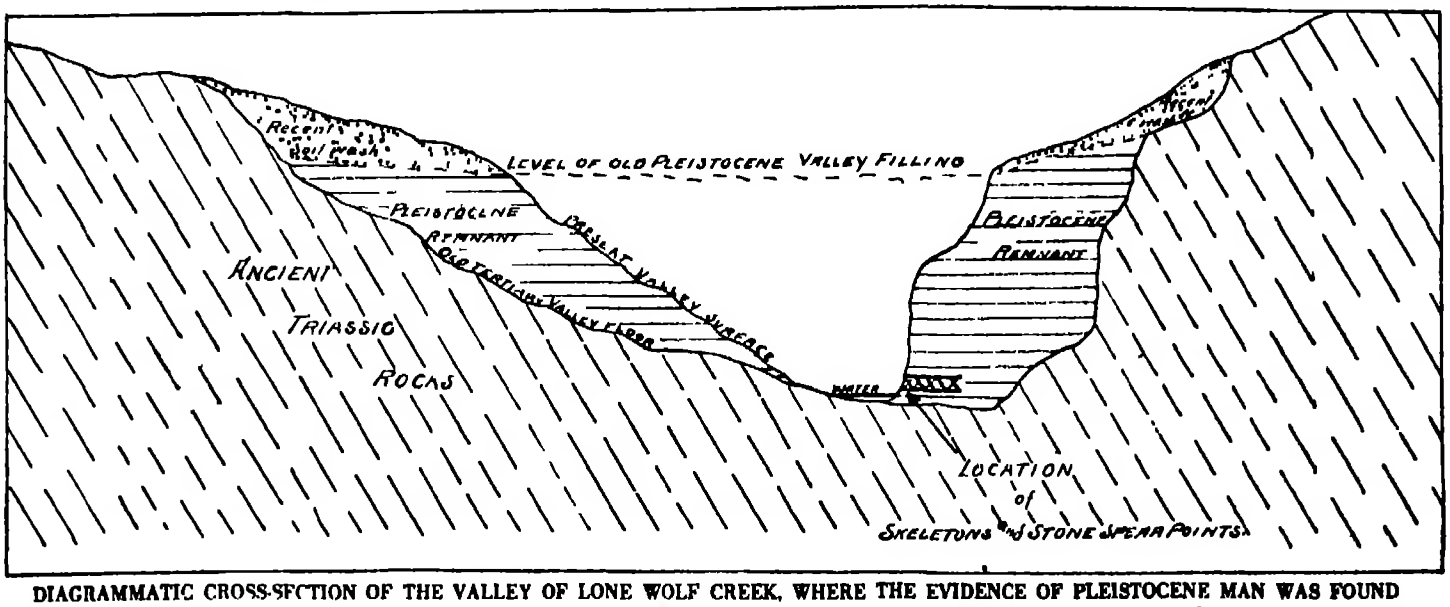
Through the persistent work of a few men in the last few years, however, a great deal of pertinent and striking evidence has been acquired, but scientists will be slow in announcing results until this is amplified with further discoveries and studied with the utmost care and scrutiny from all possible angles, where the possibility of human or humanoid remains are concerned This is necessary and proper where hundreds of thousands of years, or longer, are involved. We do not want to fool ourselves. We intend to *know*

"Cold Facts Are More Convincing"

Determination of the age of deposits before glacial times and, to a large degree, the problems of accurate determination of the age of glacial deposits, falls primarily within the province and special training of the geologist and chemist, and not the anthropologist In the past few years, several reports have been made of the finding of man or his implements in deposits of probable Pleistocene age. Some of these discoveries may not be old, others almost certainly are, and the finding of the Pleistocene artifacts above mentioned in unquestioned Pleistocene in Texas should go a long way toward removing categorical denials of the possibility of glacial man in America Logic and inference are invaluable but cold facts are more convincing

We are finding in North America, China, and Mongolia at this time numerous geological and paleontological evidences of interrelationships, and some of these relationships certainly go back into millions of years While early man is even yet little known, he is certain to be known better and "traces along the road" will be found that are indisputable.

It is well to keep another point in mind Modern methods are now as never before making possible the working out of sub sea geography in the great oceans. With this comes a better appreciation and understanding of the instability of the earth's crust and the lack of permanence of land areas There is a strong suggestive evidence of other ancient land connections from the south, besides that of the Bering Straits—connections that may prove to have had a far stronger hand in shaping the life-destinies in America of both man and beast, than we are as yet prepared to admit With these and many other considerations in mind, we await tomorrow's discoveries, knowing they will come and feeling certain they will show our human history of America back into, through and beyond, glacial times



DIAGRAMMATIC CROSS-SECTION OF THE VALLEY OF LONE WOLF CREEK, WHERE THE EVIDENCE OF PLEISTOCENE MAN WAS FOUND
The relations of the several geologic formations are clearly shown, while the details of the situation under which the evidence was found is explained in the text

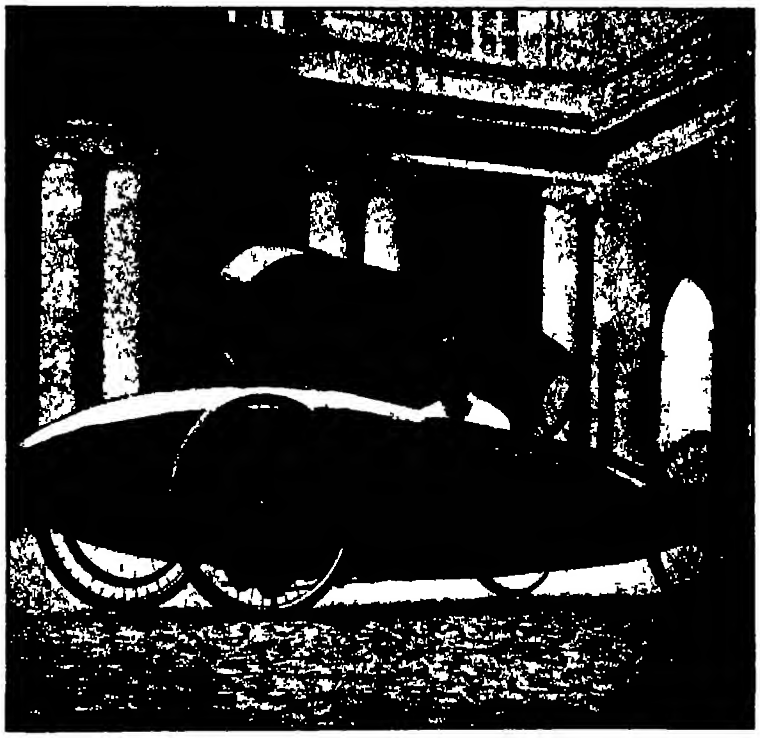
Wide World Photos

THE "LANDSKIFF" IN OPERATION IN CENTRAL PARK, NEW YORK CITY

This open model of the ingenious hand-propelled vehicle devised by a German physician serves to show the component parts of the device Notice in particular the strap and handle by means of which the vehicle is propelled, the sliding seat and the underslung position of the chassis in relation to the centers of the wheels

THIS MIGHT BE CALLED A "ROADSTER" MODEL

A front view of one of the "landskiffs" without a top enclosure The low center of gravity and the four-inch road clearance are particularly noticeable in this photograph as is also the low position of the driver



LIMOUSINE MODEL WITH THE TOP UP

This is one form of the vehicle that is very popular in Germany When the top is lowered over the occupant complete protection from road dust is afforded The driver enters by stepping in with the top up as shown

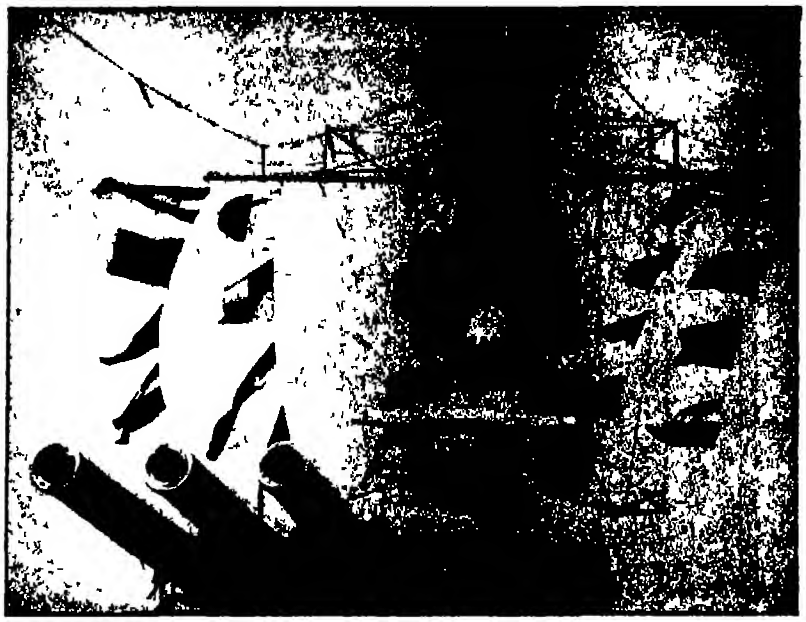
A Practical Hand-propelled Vehicle of Unique Construction

A German physician of Yankee descent, Dr Manfred Curry, has invented a novel form of vehicle which, it is said, has taken Germany by storm The photographs reproduced above give a very good idea of the machine. In essence, the mechanical features consist of a gearing and ratchet arrangement that converts successive pulls on a leather strap to a rotary motion at right angles to the pull, brakes on the front wheels and a steering arrangement for the rear wheels Entering the vehicle, the rider sits in a seat that slides on a pair of rails in much the same manner as the seat in a rowing shell. His feet rest on strongly braced projections and a handle fastened to the strap is in easy reach. Propulsion is obtained by pulling on this handle and exerting the force in much the same manner as oars are manipulated in rowing It is said that the device is easier to propel than a bicycle and that the exercise afforded by it is very beneficial Speeds of 35 miles per hour are said to be obtained with little effort on the part of the driver The inventor is now in America, surveying the field here for his device Factories in Germany have turned out in excess of 46 000 of the vehicles at the time of writing and they have become very popular probably because of the high cost of gasoline and automobiles in that country Whether the device will find favor in the United States is problematical, due to the low cost of private motor transportation here

All illustrations U. S. Navy Official Photographs

TWO FORMS OF NAVAL SIGNALING

The man at the right is reading a signal from the flag ship The two at the left are hoisting corresponding flags The man in the background is sending "semaphore" signals



FLAG HOISTS ON THE U.S.S. "PENNSYLVANIA"

The four strings of flags flying from the foreyard are all separate signals and each one has a meaning of its own These strings are used for inter-ship communication

Reducing Errors in Navy Signaling

A System of Denoting the Letters of the Alphabet by Special Names Has Been Found Highly Effective in Increasing Accuracy

By Alfred P H. Tawresey

Lieutenant-Commander, United States Navy

WHO has not experienced difficulty in making other persons understand names, numbers and other commonplace items over the telephone, even when the connection was faultless? Are such incidents due to faults of the speaker or shortcomings of the listener? Neither one, for the root of the trouble is, in the final analysis, a defect of the language itself.

Familiarity with the subject under discussion and a running knowledge of the context doubtless aids in mutual comprehension. However, even with such knowledge at command, ordinary speech, rendered perfectly, is inadequate where extreme precision is required.

Telephone operators pronounce and accent words and numbers in a manner peculiar to themselves, and use stereotyped phrases, monotonously familiar, but distinctive and precise This is the result of a deliberate system of training, designed to promote uniformity and thereby to minimize chance of error.

Naval Telephones Are Different

All sailors come from the land They learn in infancy that one side of the body is "right" and the other is "left." It is essential in maneuvering a ship, however, that when one speaks of a given side of the vessel, the meaning be absolute and not relative to the direction in which speaker or listener happens to be facing Hence the terms "port" and "starboard" were adopted in the dim and distant past, to mean definite sides of the ship, entirely independent of her direction of travel, position, or the position of the people in her

When a warship goes into battle, or even when she exercises in preparation therefor, officers and men are at their several stations They are separated by myriads of decks, bulkheads and doors In order that activities at the several stations may be coordinated, they must be able to communicate orders and information In many cases mechanical and electrical devices serve well enough for conveying the pre-determined meanings for which they have been designed. However, many things must be communicated besides those which can be foreseen and provided for by means of instruments. For such communications there are telephones and voice pipes

In a man of war the telephones differ considerably from those in common use on shore, insofar as their mechanical construction and the manner of their use are concerned Instead of a person at each end of a line, the lines usually connect several persons at different stations Head phones and breast plate mouthpieces are in universal use It is obvious that these telephones must be ruggedly built, and a night watch in a tropical sea loses some of its romance when it involves wearing one of the sets for four hours at a stretch.

ON WATCH WITH A TELEPHONE

Silhouette of a sailor wearing a navy telephone with a breast-plate transmitter and a pair of earphones

The greatest need for precise speech in the Navy comes in the handling of signals. Signals are arbitrary combinations of letters and numbers, used to convey whole sentences The condensation of meanings into the brief, compendious form known as signals is a practical necessity in coordinating a fleet.

Signalmen who read visual signals must stand in exposed places in order to see them, and what they see must be communicated to the commanding officer as rapidly as possible and with absolute accuracy. They may communicate by telephone, voice pipe or by word of mouth. In any event there are often many things to contend with, such as hampering gas masks, wind and weather, whistles, gunfire and machinery noises, as well as bells, buzzers and other necessary but noisy devices in a man-of-war.

"Hypo-affirmative-tare" Spells "Hat"

It was early discovered in the Navy, as elsewhere, that the ordinary sounds by which we know the letters of the alphabet and the numbers do not provide the necessary accuracy, even under favorable conditions This is for the very elementary reason, inherent in the language, that differentiation between many letters with a similar sound depends upon the consonants in the sound Except when within easy hearing of a person speaking, and when reasonably free from any interfering noise, many of the consonants, such as "t" or "h," cannot be heard. There are others, such as "s" and "z," which have, so to speak, more carrying power. Still other consonants depend for carrying power almost entirely on their associated vowel sounds, such as, for example, "b," "d," "m" and "n"

The natural solution to the problem of accurate communication was to name each letter and always to speak of the letter by its name. When the system was first tried, each person was permitted, to use names of his own selection for the letters. This process was similar to that sometimes used in private life, where one will spell a word in the following

"UP ANCHOR"—USING SIGNALS
Even in this part of naval maneuvering, the signal men with their telephones are indispensable

manner: "hat, 'h' for Henry, 'a' for apples, 't' for tiger"

This method did not prove entirely adequate. There was a lack of uniformity which did not aid accuracy. Individuals chose names of varying length. Some were briefer and consequently more efficient for naval purposes. To remedy this condition it was decided to adopt a standard list of names.

From the experience with this first standard list of names for letters, it was determined that it is necessary in some cases to have words of two or more syllables, with a distinctive vowel sound in each syllable. Accuracy then depends upon the recognition of successive vowel sounds, following each other in a prescribed order, the specific sounds for each name and the order of sounds being sharply differentiated from that for any other name in the list.

It is interesting to observe the difference between these principles and those upon which shorthand is based. In shorthand the vowels are omitted as being understood and are supplied by the stenographer when transcribing the completed work. In the Navy's method of communicating the letters of the alphabet, the consonants often are not heard. The listener mentally supplies the consonants which he has been trained to know belong in those particular words, as designated by the vowel sounds.

In revising the list of names of letters for the Navy, some letters which had not given any special trouble were changed to make the names coincide with certain secondary meanings used in some naval work. Furthermore, an abbreviation of the name is permitted, where it is necessary to write the name instead of writing only the letter. The list of names for the letters of the alphabet, as revised, is as follows:

A—AFFIRMATIVE (written Afirm)
B—BAKER
C—CAST
D—DOG
E—EASY
F—FOX
G—GEORGE
H—HYPO
I—INTERROGATORY (written Inter)
J—JIG
K—KING
L—LOVE
M—MIKE
N—NEGATIVE (written Negat)
O—OPTIONAL (written Option)
P—PREPARATORY (written Prep)
Q—QUACK
R—ROGER
S—SAIL
T—TARE
U—UNIT
V—VICE
W—WILLIAM
X—XRAY
Y—YOKE
Z—ZED

Difficulty in comprehending spoken numbers has not been so great as was the case with letters. All numbers are considered as being made up of the digits composing them, so that the ten sounds, "one" to "nine," inclusive, and "zero," serve to convey any numerical value. The principal difficulty which has been encountered has been the similarity of sound, under adverse hearing conditions, between "nine" and "five." This has been obviated by pronouncing "nine" in the normal way and by pronouncing "five" as though it were spelled "fife." In some special cases numbers are passed in other than the single digit form, and in these cases some difficulty has been encountered in distinguishing between "fifteen" and "fifty." In this case "fifteen" is pronounced normally, but "fifty" is rendered "fife ty."

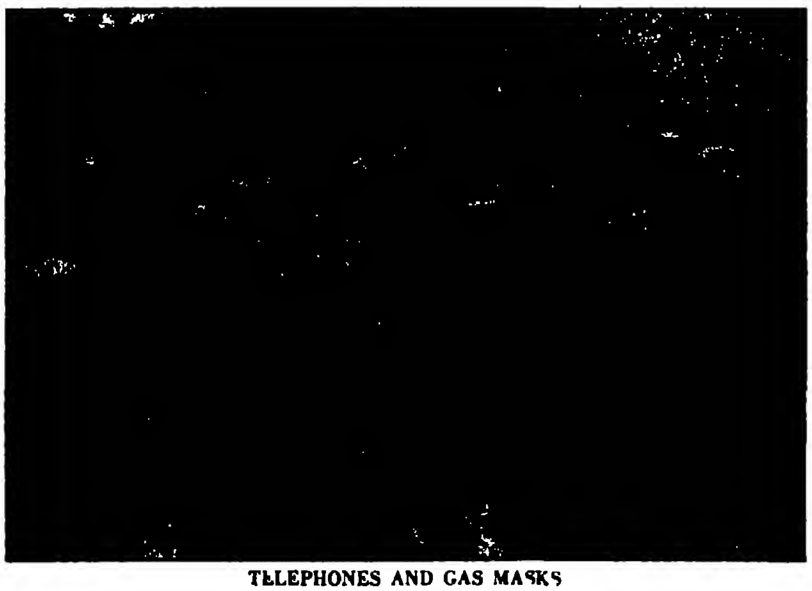
In the Navy there often is occasion to send telegrams in which appear single letters, or combinations thereof. In the case of trademarks, drawing numbers, arbitrary designations and similar items,

UP IN THE AIR WITH A TELEPHONE
The cable of telephone wires is fixed to the line that holds the observation balloon to the ship

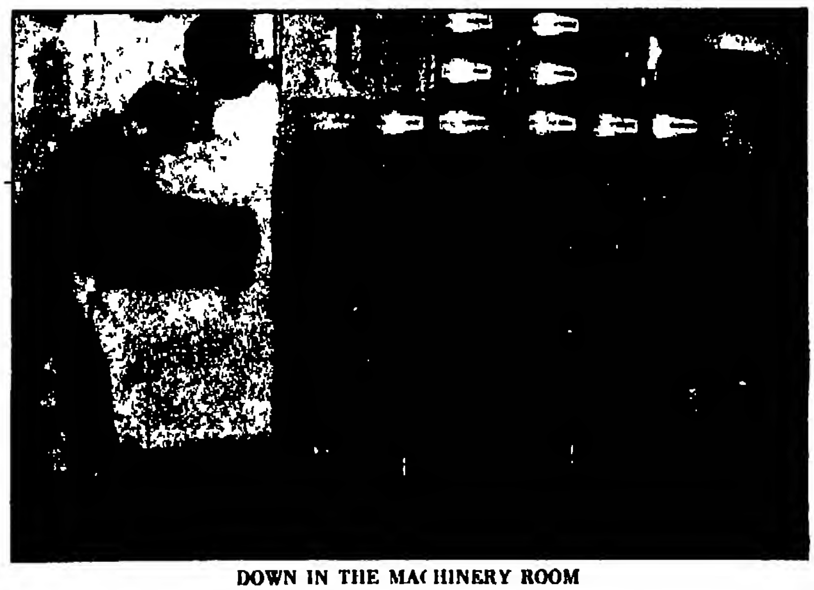
it is frequently essential to the value of the message that the addressee receive single letters and numerals correctly.

In private life there exist a few isolated instances of attempts to secure accuracy in the case of frequently mistaken items. For example, "Eye" is sometimes written for "I," and "You" is written for "U." If, as in the Navy, there exists between writer and reader, or between sender and addressee, a standard practice of rendering all numerals in words and of using specified names for all single letters of the alphabet, or for the individual letters of occasional detached groups, the chances of error due to the telegraphic agency will be minimized. Mistakes in spelling are ordinarily not enough to prevent the addressee from understanding the meaning intended.

Spelling over the telephone would be speeded up and would be improved in accuracy, if instead of using an optional and individual set of names, which have to be explained, and which may be ambiguous, a standard, unmistakable set could be employed. Reverting to the example of spelling the word "hat" over the telephone, it is obvious that accuracy would be promoted, and that time would be saved if the public understood a common system and if "hat" were designated in such cases by saying "hat, hypo-affirmative tare."



TELEPHONES AND GAS MASKS
With gas masks adjusted and under fire, communication is necessary at all times. The hatless sailor behind the gun is wearing a telephone for sending and receiving orders



DOWN IN THE MACHINERY ROOM
The man at the left is receiving orders by telephone. He has to contend with machinery noises as well as two loud-speaking telephones located near his head, one of which shows

Herbert Photos

AN ALTERNATING-CURRENT RECEIVER

Francis R Hoyt, third from left, who developed this set that operates from the house-lighting socket At the right is Lambdin Kay, announcer at WSB, Atlanta, Georgia

Herbert Photos

ONE OF THE 1926-27 RADIO STYLES

A new eight-tube set built on the neutrodyne principle and tuned by a single control that makes ten adjustments Note the metallic shields and frame of this receiver

Autumn Styles in Radio

Alternating-current Operated Receivers Are An Outstanding Development

By Orrin E Dunlap, Jr.

AUTUMN brings new styles in radio equipment and a survey of the etherial "fashions" reveals that the sets operating in connection with the house-lighting mains, thereby dispensing with batteries, will lead as the outstanding development this season. The importance of this type of apparatus is seen in the light it casts on the main trend of radio progress It is expected that the batteryless circuit will gain rapidly in popularity, just as soon as the public is convinced that such receivers are practical, and that five years hence this type of set will be most generally used. As a new factor it will undoubtedly stimulate radio replacements and the sale of receivers to a wide extent.

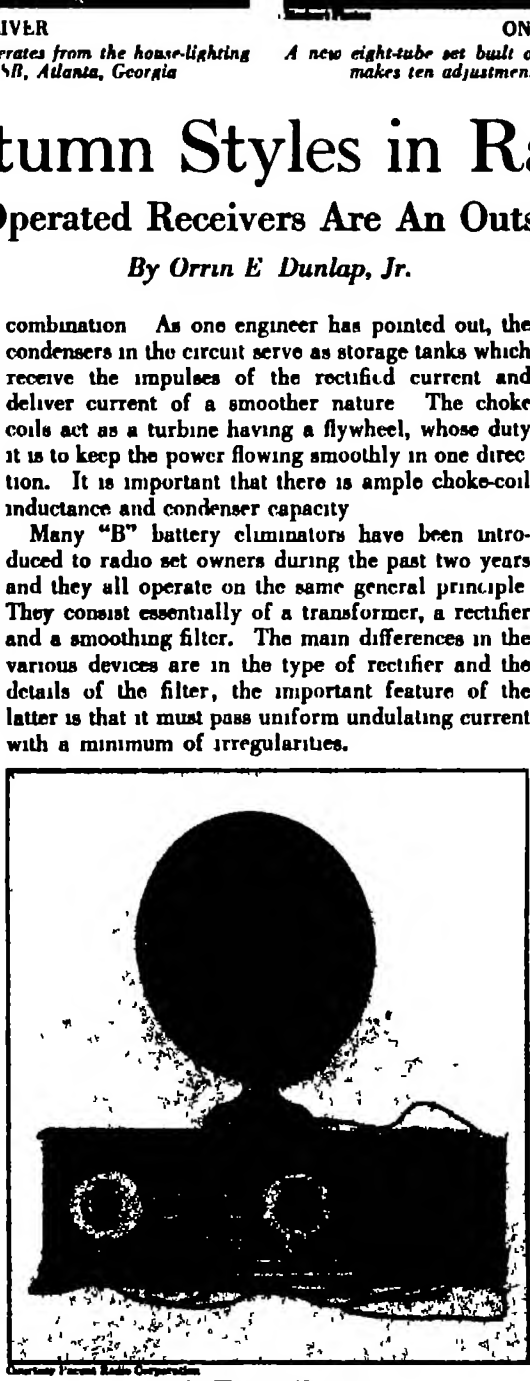
Those who have been waiting for the batteryless sets will find a variety on the market this season, and those who now have battery operated receivers in their homes will find that the new combination "B" eliminator and power amplifier will aid in modernizing the old equipment by supplying the "B" voltage to the tubes, and by improving tone quality and volume.

The Hum Presented Chief Problem

Ever since broadcast receivers took their place in the American home, radio engineers have realized that the batteryless set was in demand. But it has been a problem to adapt radio receivers to use alternating current without producing a hum. The puzzle has been tackled from two angles Some engineers have tried, from the beginning of their endeavors, to produce an alternating current tube Others, taking cognizance of the fact that there are millions of receivers in use equipped with battery-operated tubes, have directed their attention to current-supply devices designed to rectify the alternating current of the house lighting system to direct current of the proper voltage to operate battery type tubes

Rectifiers and filters, which form the basis of most battery substitutes, are not new devices. They were used long before broadcasting began in 1920 A German patent granted to Koch and Sterzel on December 5, 1906, showed rectifiers and filters in combination As one engineer has pointed out, the condensers in the circuit serve as storage tanks which receive the impulses of the rectified current and deliver current of a smoother nature The choke coils act as a turbine having a flywheel, whose duty it is to keep the power flowing smoothly in one direction. It is important that there is ample choke-coil inductance and condenser capacity

Many "B" battery eliminators have been introduced to radio set owners during the past two years and they all operate on the same general principle They consist essentially of a transformer, a rectifier and a smoothing filter. The main differences in the various devices are in the type of rectifier and the details of the filter, the important feature of the latter is that it must pass uniform undulating current with a minimum of irregularities.



Courtesy Farrand Radio Corporation

A NEW POWER UNIT

The "Powerformer" in the small case at the right connects to the house mains and supplies the plate voltage for all tubes It also serves as a power amplifier

There are now two general groups of rectifiers, the vacuum tube and the electrolytic types. The tube rectifiers are either of the thermionic valve type or of the cold cathode, gas-filled bulb. It is these rectifiers which are rapidly gaining in popularity, because they are compact and there is no liquid to handle or spill

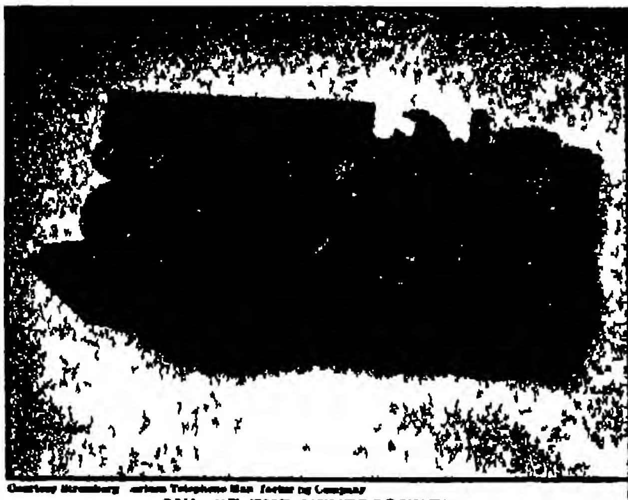
Engineers explain that the main disadvantage of the tube rectifier is that their high internal resistance necessitates the use of a high-voltage transformer, and therefore, about 80 percent of the current consumption goes to generate heat in the rectifier tube.

Two types of electrolytic rectifiers are used in "B" power units One uses tantalum as the rectifying electrode and the other employs aluminum. The electrolyte is sulphuric acid in the tantalum rectifier A solution containing several salts is used in the aluminum rectifier

A Tube Without a Filament

Some receivers, generally those using radio-frequency circuits with one or more reflexed stages and operating in conjunction with loop antennas, are often difficult to operate with a "B" eliminator without a hum even when the best filter system is used. Receivers which are very sensitive to magnetic induction caused by the transformer of the power unit are likely to show signs of a hum. In such cases the power unit must be placed further from the set or heavy shielding must be employed.

Despite the progress being made in developing battery substitutes, there will always be a demand for battery-operated receivers because millions of homes are not equipped with electricity. However, there is every indication that the house-current operated sets will win favor among radio set owners this season and within five years the power set will be more in demand than the battery-operated circuit. It is probable that the sets using alternating current will employ fewer tubes than the present sets, because it is expected that alternating-current tubes will be capable of handling more current and therefore give increased volume without distortion. Ten years from now there probably will be few receivers equipped



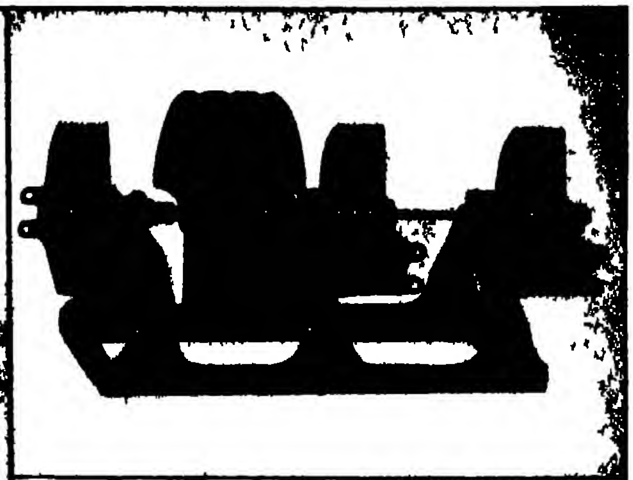
Courtesy Stromberg-Carlson Telephone Manufacturing Company

ONE OF THE NEUTRODYNES

Note how the three tuning coils or neutroformers are housed in heavy copper cans and how two tuning condensers are mounted on a single shaft and controlled by one dial

ALTERNATING CURRENT TUBE

This tube fits a standard socket but the alternating current filament terminals are on the top



Courtesy Alden Manufacturing Company

LOCALIZED CONTROL UNIT

This is one of the new tuning condenser units which dispenses with dials. The controllers extend through the panel of the set and may be easily revolved by the fingers

with more than five tubes including the power amplifier, which will have no tendency to overload.

For a long time the main obstacle to the majority of manufacturers of "B" eliminators was the rectifier tube. Now there are several rectifier tubes on the market: the UX 213, a full wave rectifier giving an output of 65 milliamperes, the UX 216 B, a half wave rectifier with 65 milliamperes output, and the Raytheon tube, which is said to be built upon an entirely different principle, the forerunner of which was the "S" tube. The underlying principle is that any gaseous tube which has one very small electrode and one large electrode is a partial rectifier, that is, the current flows more readily when the larger electrode is made negative than when it is positive.

This tube has no filament to burn out and requires no rheostat. Helium gas is used inside the bulb. A quart of helium at atmospheric pressure is said to be sufficient for 700 tubes. The tube depends upon ionization for its action and therefore the vacuum is not nearly as perfect as in the standard radio tubes. The type BH Raytheon tube will pass 85 milliamperes.

For years scientists searched for insulators that would stand up under intense heat and would not break down under extremely high voltage stress or deteriorate with age. Mica, lava, glass and porcelain, all were tried without avail.

After years of development work on gaseous rectifiers, C. G. Smith of Cambridge, Massachusetts, discovered that the desired insulator was the very gas with which he was working. It was found that this and other gases would not conduct current between two electrodes that were close together. The Raytheon rectifier was built with this "short path" insulator as the foundation.

One of the problems was to produce an electrode surface that would give the most satisfactory performance. Dr. Vannevar Bush, Professor of Electrical Engineering at the Massachusetts Institute of Technology, was the leader in this work. Under his direction a special heat treatment was developed that not only assures long life for the tube, but also lowers the voltage drop. This makes possible excellent regulation or, in other words, the ability of the device to hold its output voltage at varying conditions of load or current drawn.

Glass as a Rectifier

There is one alternating current tube which eliminates the necessity of "A" and "B" batteries. This tube has the combined features of a rectifier, detector oscillator and radio frequency amplifier. As a power amplifier the tube is rated with an amplification factor of eight. The bulb has a metallic base, which is used as the fifth connection. The base is connected to the cathode which controls the electron emission. A plate voltage up to 200 volts may be applied to the tube without danger of overheating. The cost of operating this tube is estimated to be one cent per hour for a five-tube set. The life of the tube is about the same as the present battery operated tubes.

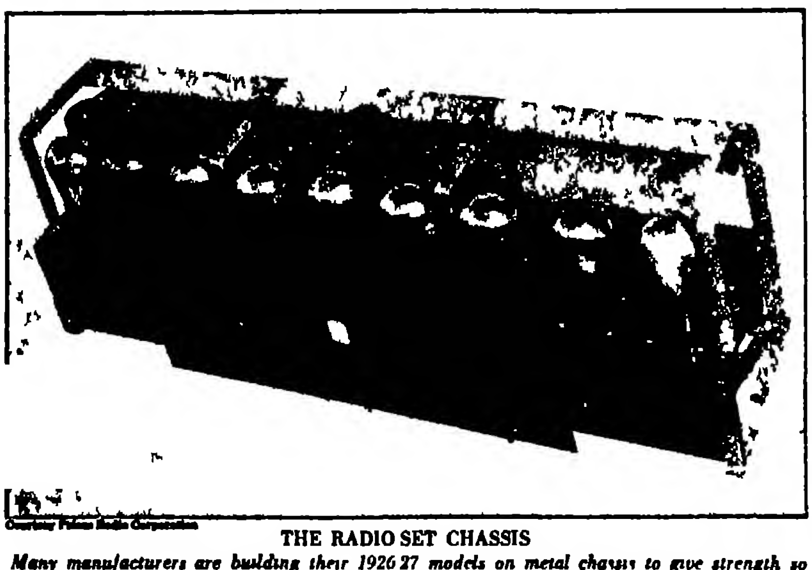
It is estimated by engineers that the house current operated sets on the average will consume energy at the rate of approximately eight kilowatts a month.

A new instrument known as the "Transifier" was introduced to radio fans this fall. It furnishes either two, four or six volt filament current supply for operating multi-tube sets consuming not more than 2½ amperes. A built-in automatic switch controls both "A" and "B" power units when the receiver is in use. The cost of operation is estimated to be approximately one half cent per hour.

There is also a "B" Transifier which operates directly from the light socket eliminating both "B" and "C" batteries. It supplies current up to 60 milliamperes at 45, 67½, 90 and 150 volts and also 4 and 12 volt "C" battery current. This device will operate with sets equipped with ten tubes or less. A single control adapts the output to the proper current requirements.

The "B" Transifier is also built in a smaller model designed to supply the plate voltage for sets using six tubes or less. The maximum output is 100 volts and it is estimated that the cost of operation is less than one tenth of a cent per hour.

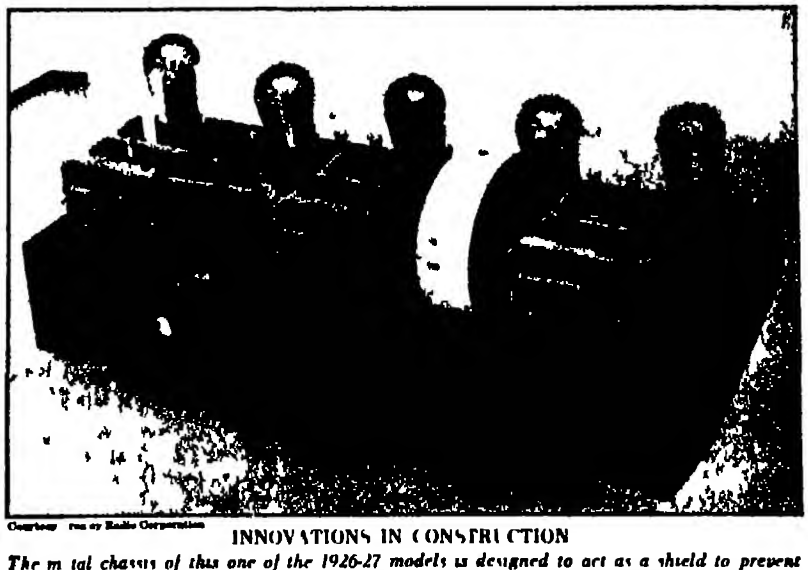
"Silite" electrodes are another new feature this season. They are metallic glass rectifying elements, based upon the rectifying property of silicon, or sand. They are said to give a higher charging rate than most electrodes. Silite makes possible the conversion of "A" batteries into "A" power units.



Courtesy Freed-Eisemann Radio Corporation

THE RADIO SET CHASSIS

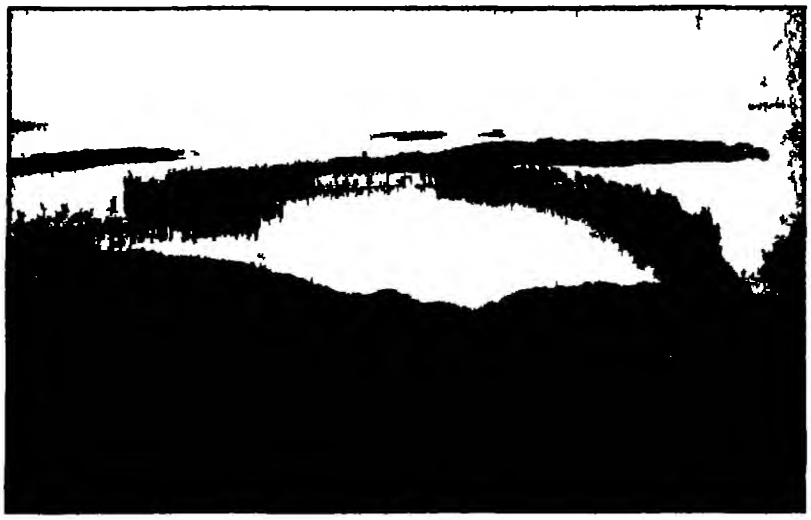
Many manufacturers are building their 1926-27 models on metal chassis to give strength so that the instruments will stand shipping and will not be too delicate for the handling that they will get in use. The model shown is known as the "Straight 9"



Courtesy ... Radio Corporation

INNOVATIONS IN CONSTRUCTION

The metal chassis of this one of the 1926-27 models is designed to act as a shield to prevent interference from outside electrical influences. Note how the condensers are built on one shaft and tuned by the drum control on which the wavelengths may be recorded



HERRING WEIR EASTPORT MAINE

Fish enter this brushwood weir at the left and swimming to and fro against the opposite side of the weir fail to find their way out

STONY POINT POTOMAC RIVER

A shad fishery seine on the Potomac just before being landed The seine paid out in a half circle is drawn in to the beach

Uncle Sam, Spendthrift—VI

The Destruction of Many of Our Finest Fisheries Has Been Only Less Complete Than the Destruction of Our Forests

By J Bernard Walker

IT is a strange anomaly that in this age of free inter communication and of wide and rapid diffusion of knowledge, so many people should live in complete ignorance of certain serious economic conditions, which threaten the continued welfare and happiness of these United States We have in mind the facts which have been revealed in the present series of articles on conservation In this survey we have endeavored, without any exaggeration or sensationalism to show that in drawing upon the rich, natural resources of the country our forbears, and for that matter we ourselves have apparently taken absolutely no thought for the future with the result that we have swept away four fifths of our marvelous forests and have skimmed the cream of our great supplies of oil and coal, leaving of the last named only the inferior fields for the use of a future population which is growing by leaps and bounds and making an ever increasing demand for these necessities

It is certain that nine out of ten men, we had almost said 99 out of a 100, have never given any thought to the seriousness of the rapid depletion of our forests, although it is going on daily under our very eyes and, so long as they could get all the oil they wanted at the filling station the vast majority of the people of the United States have thought little and cared less how the oil was secured and whether the supply was in danger of exhaustion

In the present chapter on the depletion of our fisheries we deal with another question of vital importance to the future well being of our country At the outset, we ask the reader of these lines if he is aware that Uncle Sam has been such a spendthrift in using up the magnificent supplies of fish with which God had stocked our rivers lakes and coastal water, that some of our most prolific fishing grounds have been depleted to exhaustion, and some of our most delicious and most sought after species of fish have been practically swept out of existence

Fish Supplies Reduced One Half

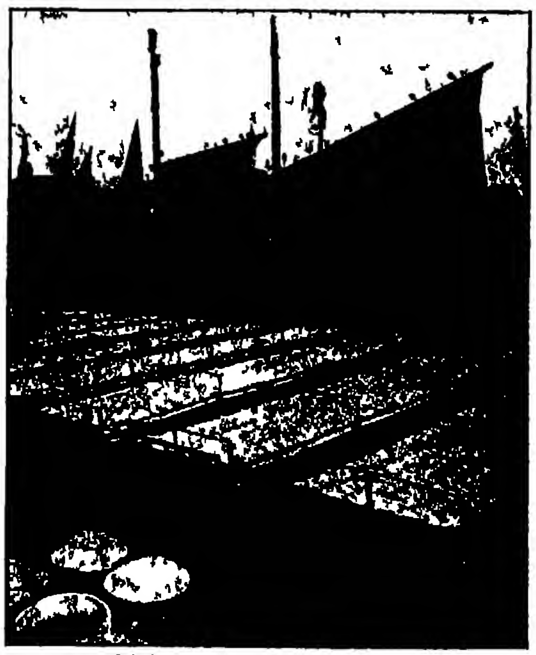
Now if you do not know this and if you are inclined to doubt so strong a statement, we refer you to certain government statistics of our fisheries as set forth in recent years by Mr Hoover, Secretary of the Department of Commerce, in many an urgent message of warning

Learn then that, although our Atlantic and Pacific littoral waters once teemed with huge runs of salmon, shad sturgeon and mullet to say nothing of great stocks of lobsters, crabs, oysters and clams, the very ease with which the fish could be caught has led to their undoing "Our great supplies of salmon on the Atlantic Coast," we are told, "have totally disappeared as a food supply" Granted, you say, but look at the great Pacific Coast salmon fisheries Well even here the salmon supplies have diminished by over 50 percent, and it is only within the last few years that the government has taken measures to stop the destruction Even in Alaska, the remaining great salmon fishery of the world, reckless exploitation has threatened the extinction of the salmon within half a generation Fortunately, two years ago the government put in force measures which promise to save this great fishery The sturgeon fisheries have declined 98 percent in some 42 years on the Great Lakes and they are almost gone on our coast The yield of the shad fisheries has decreased over 70 percent Seventy seven years ago 22 000 000 shad were taken in the Potomac River alone in a single year whereas today we are told that 800 fishermen take with difficulty less than 600 000 fish per year from this river and the Potomac, bear in mind is the finest of the remaining rivers for shad

The same story of depletion applies to the river herring striped bass, and sea trout which are decreasing rapidly as are the supplies of crabs lobsters, oysters and clams As late as 1915 the Chesapeake and Delaware crab fisheries yielded over 50

ABOARD AN ALASKAN FISHERMAN

A good catch of codfish, as the result of only 20 minutes fishing with hand lines



IN OLD GLOUCESTER HARBOR

The cod, after being cleaned are spread out on wooden racks and left to dry

000,000 pounds, but today the yield is less than one half of that. The oyster fisheries of the Chesapeake have fallen 50 percent in the short period of 20 years, and our lobster catch is less than one third of that of 30 years ago. Uncle Sam certainly has been spendthrift of his wealth in fisheries, and the above enumeration, mark you, refers only to littoral and inland fisheries. It is a fact that even some of our deep sea fisheries, such as those of the halibut in the Northern Pacific, already have been over fished.

Let us now look at the question of fish supply from a new angle—that of sport and recreation. "Game fish," so called, although they do not bulk largely in the question of food supply, are of the first importance as affording one of the healthiest and most popular means of outdoor recreation. Secretary Hoover, in an address delivered in 1924 before the United States Fisheries Association, referring to the effect of the automobile and good roads in sending the people outdoors for recreation said: "I do not consider it an exaggeration to say that this summer will have seen two million anglers upon our streams and coast. In one state alone 200,000 individual (fishing) licenses have been issued this year." There is a consensus among devotees of the rod and line that game fish are decreasing rapidly under this pressure.

Protective Legislation Necessary

Not only do the fishermen reduce the number of fish that reach the spawning grounds, but there is another and most serious obstacle in the shape of the dams which are being built in increasing numbers across the rivers and streams of the country. The reservoirs thus formed, many of which reach for a score of miles or more back through the valleys, cover up at times, favorable spawning ground for fish, and the dams themselves form an insuperable obstacle to the progress of the fish up the rivers. Around such dams as are not too lofty for the purpose fish ladders should be constructed.

The obvious method of control here would be for the states and the Federal Government to combine in some form of protective legislation similar to that which is doing such fine work in the protection of our migratory birds—a subject which we shall deal with in a subsequent chapter of this series.

An even more destructive enemy of our game fish is the pollution of our rivers and streams by sewage and by the wastes poured into them in ever increasing amounts from the towns and villages through which they flow. Already this cause alone is answerable for

THE GREAT MENHADEN FISHERY

This view shows the fish being bailed from net to be dumped into the hold of a schooner

the extinction of the fish in many streams that once were prolific fields for the fishermen, and the process of destruction goes merrily on. Such great strides have been taken in late years in the development of sewage purification plants that the various state legislatures would be justified in prohibiting the discharge of sewage into our rivers. The habit, judged from the esthetic side, is a filthy one in itself, a survivor from an earlier and cruder period of our history. Not only the sewage of the population but the liquid wastes from the various factories are pernicious. Stream pollution should be stopped by the strong arm of a law backed by a clearly expressed public opinion. When that has been done and a proper control of fishing licenses and technique is everywhere enforced, our streams will flow in their pristine purity and will teem once more with fish.

Just here a word of warning. We must not be deceived by the enormous gross value of our fisheries' products. The annual increase has been brought about by increased prices, increased number of fishermen, and by a very great increase in the *proportion* of deep sea fish. Do not forget in looking at these great and growing figures, that they are accompanied by a great decrease in the quantity of littoral fish that has been caught and by a marked decrease in the catch per man.

It is probable that there are young people among us who will live to see the day when the population (and hence the food demand) of the United States has been doubled. In this matter of conservation we owe a duty not merely to our own, but to future generations. We have painted a deplorable picture of the spendthrift policy or lack of policy which has characterized our attitude toward fisheries during the past life of the nation. What of the future? Can the mischief be repaired? Will there ever come a day when our coasts and inland bays will be alive once more with those valuable species of fish which, as we have seen, are now well nigh extinct?

States Must Cooperate

The answer is emphatically Yes, and the work can be accomplished by hearty cooperation among the states and between the states and the Federal Government. Hitherto in this as in other matters affecting the general public welfare, the states have been divided by their age long jealousies and suspicions. If we are to achieve results in solving this fish problem, the states must get together and do so quickly. Already a start has been made, and the following facts show that the work is progressing satisfactorily.

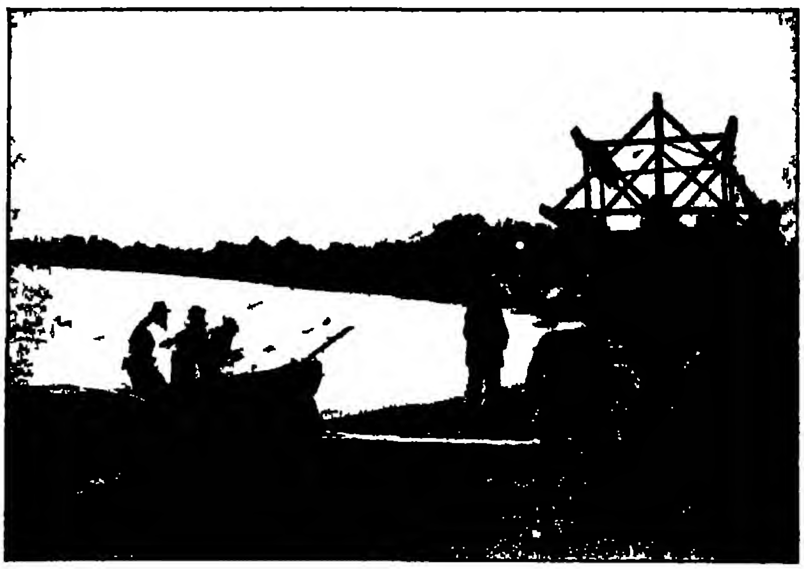
Firstly, Congress enacted last winter federal legislation controlling oil pollution of coastal waters. Secondly, by negotiation with Canada we have secured the Pacific Coast Halibut Treaty, under which the two nations can stop the depletion and start the recuperation of that great fishery. Thirdly, Congress some two years ago enacted the Alaskan Salmon Fisheries Conservation Bill, and as a result destruction has ceased and the rejuvenation of these fisheries is in active progress. Fourthly, there has been passed by Congress the Upper Mississippi Fish and Game Refuge Bill. This means that the streams of the Upper Mississippi will be preserved for the breeding of fish and game. Lastly, Congress has met with some success in bringing about cooperation between different states for the protection of fisheries.

We have sketched the problem of our fisheries only in broad outline. Limitations of space prevent any detailed account of the Bureau of Fisheries, whose activities form the foundation of all constructive conservation. An adequate description of the fine work of this Bureau would call for a complete chapter in itself.

In a future issue will appear another article of this series which will deal with the depletion of game in the United States and the work which has been accomplished in game protection, notably as regards our migratory birds.

THE BOSTON FISH PIERS

A fleet of schooners discharging fish from the Newfoundland Banks. Their topmasts have been removed and motors installed. Few schooners use sail only



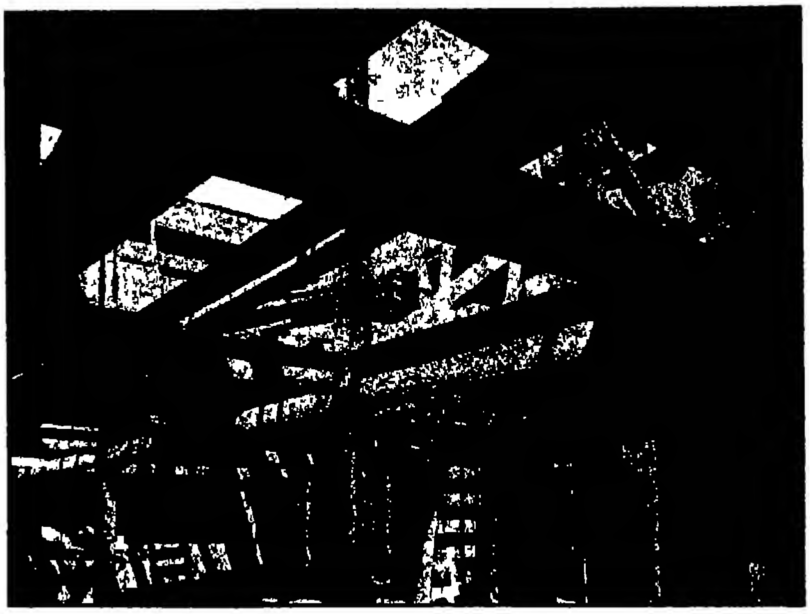
ROLLING UP GILL NET TO DRY

Nets are an expensive item in the fisherman's outfit. After use they are spread on the ground or rolled on circular racks to dry so that they will not rot

All photographs courtesy Westinghouse Electric & Manufacturing Company

A TEST OF WELDED AND RIVETED SPECIMENS

At the Carnegie Institute of Technology several elaborate experiments have been carried on. This photograph shows a group watching one of the interesting tests



BEAMS WELDED TO COLUMN

This is a sample of work done at the Westinghouse plant, at East Pittsburgh, Pennsylvania. Note the smooth column and the absence of angles and brackets

Can Welding Replace the Rivet?

Tests That Have Been Made Under Identical Conditions Show That Steel Structures Fabricated With Welded Joints Have Inherent Advantages Over Those Which Are Riveted

By A M Candy

Welding Engineer, Westinghouse Electric & Manufacturing Company

WHEN American officials took over the German steamship *Vaterland* (now the *Leviathan*) in April, 1917, they found havoc rampant in her engine room. Her eight huge turbines had been dis assembled, many parts were missing, blades had been ripped off the rotors, valves and pipes had been smashed, and much other destruction had been done.

To restore order out of this chaos seemed well-nigh impossible, but it was the paramount duty of the United States to do so because the great carrying capacity of the ship was vital to the Allies' military plans. Fortunately, most of the damage proved less serious than had first appeared, and through the superhuman efforts of the group of expert machinists gathered together for this purpose, things were fairly ship shape by the end of July.

Engineers Must Be Convinced

There was one turbine, however, whose condition seemed hopeless. Its rotor had broken and jammed while it was still turning, and its cast iron casing had been fractured in 21 places. Mechanical patches proved inadequate for this repair, and the making of a new casting would have involved an intolerable delay.

The engineers in charge of the work studied the situation and finally decided to try electric arc welding.

This process, although in use at the time in steel mills, railroad shops, and some other industries, was still fairly novel, and there must have been considerable official doubt as to the success of the experiment. The trial was made, however, and four months later the *Leviathan* steamed out of New York harbor to take her place in the great conflict.

To weld by means of the electric arc, one pole of a direct-current generator is connected to the piece to be worked on, and the other is connected to a holder which carries a length of soft iron wire. The operator brings the wire into contact with the work and then withdraws it, establishing an arc. The intense heat melts the end of the wire, and molten metal drops upon the work, which also melts at the spot where the arc impinges. If the work is properly done, the result is a solid mass. In this manner, broken iron and steel castings or forgings can be repaired, cavities can be filled up, and parts can be joined together.

> **Will the Riveter Pass?**
>
> **Dawn in a large city seems to be a signal for the start of the day's noises and soon the steady "rat-tat-tat" of the riveting gun chimes in and continues throughout the day. It appears to the average observer that cities are never finished because the work of erecting new buildings goes merrily on. So does the noise of the compressed-air riveter's hammer. However, the welding process described in the accompanying article holds forth promise of relief from this nerve-racking clamor. If city ordinances can be revised to allow other construction than riveting, we may soon have taller, stronger arc-welded buildings. —*The Editor.***

One of the striking features of this process is the strength of the joints that can be made with it. If a box, building, or any other structure, put together by means of glue, cement, solder, nails, screws, bolts, or rivets, is stressed beyond the breaking point, it will ordinarily collapse by failing at the joints. But with the use of arc welding, structures can be made of steel plates, bars, angles, and other forms, which will be strongest at the joints and will resist pressure until the steel members themselves give way. Largely for this reason, arc welding is being employed for fabricating a wide variety of iron and steel products. So far, however, arc welding has not been generally adopted for steel building construction.

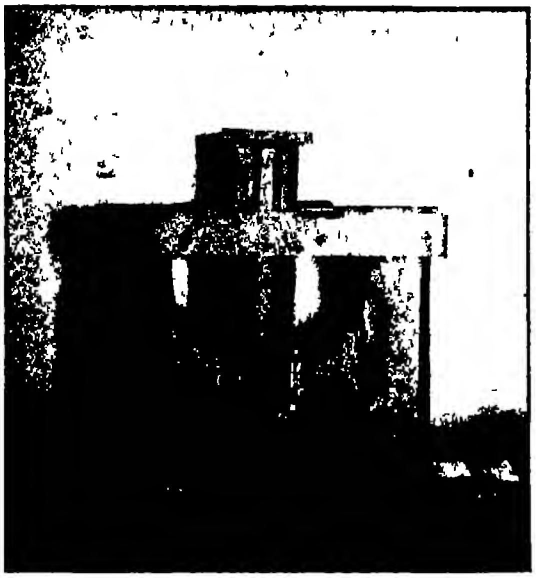
There are good reasons for this. Structural steel engineers will not consider the use of arc welded joints until they are assured beyond all doubt as to their enduring reliability, they will not abandon the perfectly satisfactory riveted construction unless welding is proved to be more economical or otherwise superior, and they cannot successfully design structures for welding until they have complete information as to the technique of welding and the unit stresses which various standardized welded joints can safely carry.

Expected to Reduce Costs

In other words, in order to introduce the general use of arc welding for structural steel work, it is necessary to erect an "arc welded" building of substantial size, which has been specially designed to take advantage of the economies of the process, calculate its exact cost, test the various types of welded joints employed, so as to secure full engineering data concerning them, and finally, thoroughly test the completed frame work.

Several arc-welded buildings have been erected in both the United States and England, but all of these are small structures and were put together in a more or less experimental way out of members designed for riveting. Hence they have failed to supply convincing data regarding either the reliability or the economy of arc welding and have had little influence on building construction.

In order to supply the need for an acceptable



JOINT STRONGER THAN BEAM
In this test sample, the strain broke the I beam itself but the welded joint remained intact

object lesson, the Westinghouse Company has contracted with the American Bridge Company to erect a five-story mill-type addition to its Sharon, Pennsylvania, plant, which is to be 220 feet long, 70 feet wide, and 80 feet high, with 22 girders over an aisle 46 feet wide. The steel work was designed specifically for arc welding by Gilbert D. Fish, consulting structural engineer, and not a single bolt or rivet will be found in the completed structure.

Typical structural members to be used in this building—including girders, brackets mounted on columns, spliced beams and bars, and cantilever forms—have been assembled by both welding and riveting and tested to destruction. Without exception, the welded specimens showed higher elastic and ultimate limits than the riveted ones, the usual excess being about 25 percent, though in some cases 50 percent greater strength was developed.

These tests provide satisfactory proof that arc-welded joints are sufficiently strong for use in steel buildings. But what about costs?

If an arc welded girder is 25 percent stronger than a riveted girder of the same dimensions, it follows that the strength of a given riveted girder can be developed by a lighter arc welded girder.

A concrete example of the savings that can be thus effected is provided by the Sharon building. Two complete designs for the steel work for this building were prepared—one for riveting and the other for arc welding. On estimating the tonnage required for each design, it was found that, while about 900 tons of steel were needed for riveting, 800 tons would suffice for arc welding—a saving of around 12 percent in the total cost of the steel.

It is also expected that labor costs can be reduced by arc welding because it is a one man job whereas four men are needed for riveting—a riveter, a backer up, a heater boy, and a passer. Tests indicate that the man-hours required to make the joints in a given structure by arc welding are almost half those for riveting, but the cost figures to be obtained at Sharon will be more satisfactory than any now available.

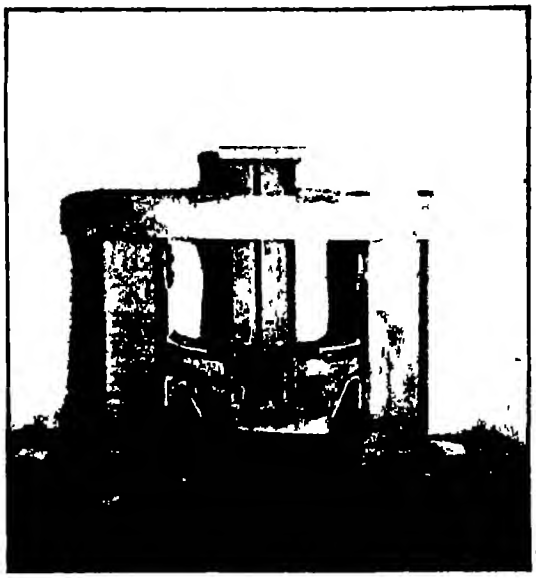
From the standpoint of the general public, the quietness of arc welding is its most appealing feature. As an example of the adverse effect of the noise of riveting, a New York hotel manager has recently stated that his hotel will lose a quarter of a million dollars of patronage during the construction of a 30 story building across the way.

Will Increase Use of Steel

Arc welding cannot now be used in city building work, however. Our city building codes are very rigid, and as all at present specify riveting for steel construction, no other method can be employed within municipal limits until the regulations are changed.

In addition to its economy, arc welding interests the structural engineer because it gives him a freer hand in building design, its permits him to take full advantage of the strength of the steel members he uses, and it enables him to obtain continuous beams of any length. It reduces the necessity for the wind bracing of tall structures by providing stiffer joints, and it simplifies shop work and greatly facilitates alterations to existing structures.

The intense light emitted by the arc will produce temporary blindness if looked at with the naked eye for a few seconds, and it will also cause painful inflammation, identical with sunburn, if allowed to fall upon the unprotected skin. Hence the arc welder has to view his work through very dark glasses of a special formula and protect his hands with leather gauntlets and his face and neck with a sort of helmet made of some non metallic material, which gives him quite a medieval—not to say grotesque—appearance. Fellow-workers and passers-by are protected from the light by curtains hung



THE RESULT OF RIVETING
The destruction test on this sample caused the riveted angles to give way under the excessive strain

around the work shutting off the harmful beams.

On the other hand, the electrical hazard of arc welding is negligible. Direct current is ordinarily employed, and the voltage drop ranges from 20 volts when the arc is on, to 60 volts when the arc is out. This voltage is too low to be dangerous, even if received at full force, and since the welder is necessarily well protected by clothing, he rarely receives even the mildest shock.

If arc welding comes into general use for structural work, it will probably increase the use of steel and doubtless bring about some radical changes in building construction. For example, the cost of constructing homes out of wood has constantly increased during the past few years, and if this continues and the cost of steel construction is reduced, the time will soon arrive when steel can be profitably substituted for wood for this purpose. This new material will give the architect increased opportunities to design for safety, comfort, convenience, and effect, and it is not unlikely that a new order of domestic architecture will come into existence.

Arc welding will also permit the erection of taller skyscrapers on given plots, and those fantastic towers, in which futuristic artists take so much delight, may some day become realities.

WHERE A WELDED GIRDER FAILED
When this building member was subjected to tests in which sufficient force to bend the girder was applied, the welded joints held and the steel plates buckled as shown

A TEST OF COMPARATIVE STRENGTHS
The yield point of a welded specimen was 50,000 pounds, ultimate load 73,500 pounds. With the riveted girder, the yield point was 42,000 pounds, ultimate load 48,700 pounds

Can We Rid City Air of Dust?

Investigations Conducted by the Weather Bureau Indicate that Atmospheric Dust Is an Important Factor in Our Lives. Much Is Being Learned About the Tiny Solid Particles in the Air

By Dorothy E. Pletcher, A.M

OF outstanding scientific value in various meteorological tests for insuring safety in aviation is the counting of atmospheric dust by the Weather Bureau at Washington, D C By means of a thorough knowledge of the character and contents of the air, it is hoped that in time it will be possible to determine all air conditions before a flight and thus eliminate the present death toll claimed by the Air Service. Today, at army and navy air stations the world over, such meteorological elements as temperature and humidity are measured regularly and frequently by means of kites and balloons.

But what of visibility? Even though the aviator has foreknowledge concerning temperature and humidity, is he aware of the distances he can or can not see on a certain day? So far, he knows nothing, but science is working on an experiment that is destined to help him in some degree Of almost equal value with the balloon atmospheric test is the counting of the particles of atmospheric dust in order to gain a knowledge of the conditions governing visibility

Counting Dust Particles In the Air

So important is this question of the dust content of the atmosphere that at the meeting of the International Union of Geodesy and Geophysics, which was held in Rome, Italy, in May, 1922, it was decided that an international study of the problem should be taken up, and provision was made at Rome for the construction of twelve dust counters, of a kind designed by Dr J S Owens of London, and for their distribution to meteorological observatories in the different countries affiliated with the union. One of these counters was sent to the United States Weather Bureau, and has been in daily use since December, 1922

From the photograph it can be seen that the Owens dust counter has three fundamental parts First, there is the dampening chamber, A, which is a tube open at one end and lined with blotting paper which is thoroughly saturated with water Second, the other end of the tube is closed by a screw-threaded head, except for a narrow slot, B, one centimeter (one third of an inch) long, and above this slot is a bed for holding a microscope cover glass When the end of the head is closed by the screwed plug, C, the three claw spring presses upon the cover glass and holds it in place Third, a passageway leads from the space between the slot and the cover glass to an air pump, D, by means of which air pressure above the slot may be reduced

This reduction in pressure accomplishes two things, according to Weather Bureau experimenters, it causes the air to pass at high velocity through the slot from the dampening chamber, and, in the second place, the reduction in pressure as the air passes through the slot cools the already saturated air below its dewpoint, and moisture is condensed upon the dust particles.

The principle on which the functioning of this instrument is based is given by its inventor, Dr Owens, as follows: "A high velocity jet of air is caused to strike a microscope cover glass; the effect of this high velocity is to bring about a fall of pressure in the jet, accompanying which, and resulting from it, is a corresponding fall of temperature This in turn causes a condensation of the moisture in the air upon the dust particles, which are thus projected wet against the cover glass, and, as the water evaporates, are left behind adhering to the glass."

Dust Reduces Visibility

If air at a given pressure and temperature is suddenly permitted to expand, the temperature of the resulting atmosphere is reduced. Thus the exhaust from a compressed air tool of any kind, such as a rock drill, is always chilly More commonplace is the opposite phenomenon, where air is compressed and therefore rises in temperature In this case the heat which a given volume of air contained still remains with it when it is compressed, but since the volume is reduced the heat allotted to a given volume is increased Reasoning from this, it is easy to see why moisture is condensed upon the cover glass of the dust counter when the air which has been compressed in the moistening chamber, A, is allowed to expand to normal atmospheric pressure and volume The advantages of accuracy, simplicity, cheapness and light weight are considerations not to be overlooked in Dr Owens' dust counter.

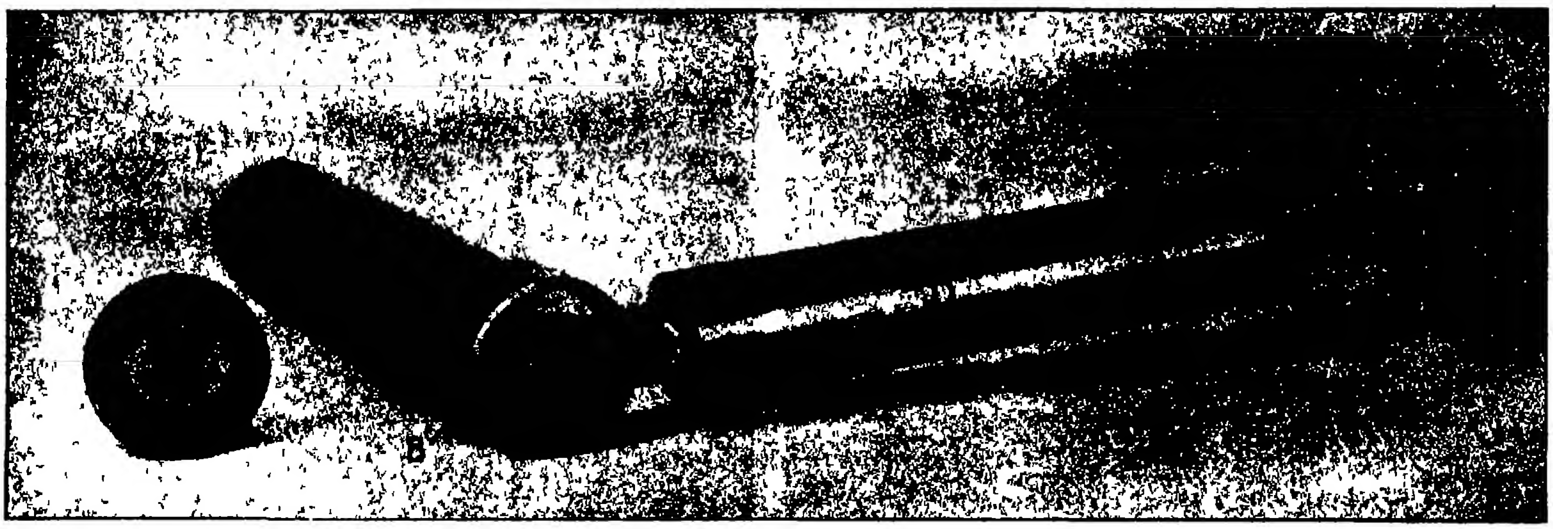
The majority of the measurements by the Weather Bureau have been made at the American University, in a suburb of Washington The others were made at the base and top of the Washington Monument, and at the main office of the Weather Bureau, both within the city. Counts were also taken in other cities, as well as during airplane flights.

What Shall We Do About It?

What is the exact nature of the haze that nearly always hovers above large cities? What is its source? What is it? Possibly smoke is the worst offender, yet all this haze is not smoke. Instead of guessing about it, scientists have recently been studying it by definite quantitative methods. They have actually been counting the number of dust particles in samples taken at various levels of the air.

One reason why there have long been so many cases of rickets in large cities is the smoke and dust in the air. These cut off the ultra-violet rays of the sunlight, and ultra-violet light is a natural preventive of that widespread bone-deficiency disease. It is only recently that physicians have come to understand these facts clearly.

"The determining factor," says Dr. Alfred F. Hess whose researches are already famous, "is the quality, not the quantity of the sun's rays—the amount and intensity of those short ultra-violet radiations which alone are of value in preventing rickets." And, adds the noted *Journal of the American Medical Association*, "Smoke pollution robs the big cities of half to two-thirds or more of this solar effect."



THE OWENS APPARATUS FOR COLLECTING AND COUNTING THE DUST PARTICLES IN THE AIR

The component parts of the instrument are plainly shown Air passes through the moistening chamber, A, by virtue of the action of the hand-operated pump, D At B is placed a piece of glass, held in place by the three fingered spring on the cap, C Dust in the intaken air is deposited on the glass and afterward is examined

DRIVEN SNOW NOT SO CLEAN
The above photomicrograph shows atmospheric residue found in a sample of snow after it had melted

In taking dust counts from airplanes, the observers discovered that the dust counter furnished by Dr Owens was not adapted to airplane work because of the fact that too many strokes of the pump were necessary to obtain a legible record on the cover-glass Then too, it was found difficult to change cover glasses between observations at the different levels on account of the high wind to which the observer was exposed. In the Weather Bureau machine shop, a dust counter with a different pump and having ten duplicate heads in which cover glasses could be secured before flights, was constructed to eliminate this difficulty

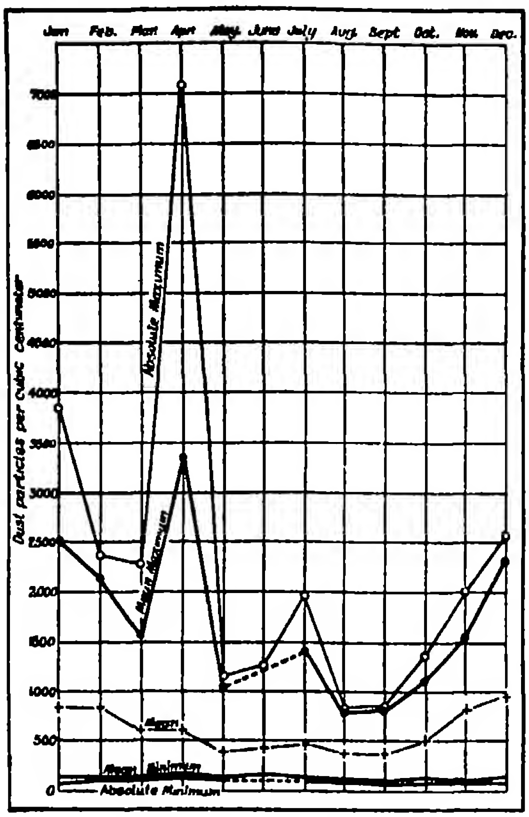
The averages of the results of dust counts taken at the American University show a marked decrease in the limit of visibility with an increase of dustiness of the atmosphere, and they indicate that the limit of visibility also decreases with increase in the relative humidity.

It has been pointed out by previous experimenters that the limit of visibility depends upon many factors, such as the intensity of the illumination of the object seen, its color, the contrast between it and its background in illumination intensity and in color Usually, say these scientists, the background is the sky and the presence of dust in the atmosphere decreases the illumination of the object, as well as the color contrast between it and the sky, and increases the glare of light in the field of view

What Is Atmospheric Dust?

From the airplane observer's notes it is manifest that cloudiness plays a most important part in the limit of visibility from the air Nevertheless, it must be well noted that when the visibility from 10,000 feet was exceptionally good, the dust content of the atmosphere was less than the average

"A summary of the results of these airplane tests," says Dr Herbert H. Kimball, who is in charge of the dust counting experiments at the Weather Bureau, "shows at the American University an average of about 850 particles per cubic centimeter in winter, and about 400 during the summer months. The extremes vary between about 4,000, on an unusually smoky day in January, 1923, and about 100 on unusually clear days throughout the year. A comparison of December, January, and February, 1922-1923 with the same months in 1923-1924 shows an excess of over 75 percent in the number of dust particles in 1922-1923, which is attributed to a general use of bituminous coal for heating purposes at that time on account of a shortage in the supply of anthracite, and due to the fact that people were unfamiliar with the proper methods of stoking their furnaces when using soft coal, there was a smokiness to the city resembling that of this past winter—the smokiest in the history of the city of Washington."



A RECORD OF ATMOSPHERIC DUST
The various lines on the above chart serve to indicate the amount of dust in the air at various times

These airplane records show that with a clear sky in the morning there is more dust near the ground and less at an altitude of between 2,000 and 7,000 feet than in the afternoon Undoubtedly, the increase at high levels later in the day is due to convection The cleansing effect of rain shows up distinctly in the records, while the difference in distribution of the dust in the atmosphere on clear and on cloudy mornings is clearly apparent

It is well known that aerial haze affects photography from the air, and the results from the bureau's airplane tests show in a measure the influence of moisture and other factors as well as dust in the formation of the haze in which we are interested.

USING THE OWENS DUST COUNTER
Irving F Hand of the United States Weather Bureau ready to ascend for upper-atmosphere tests

AT THE TOP OF WASHINGTON MONUMENT
Here air was collected and the photomicrograph reproduced above shows calcite and gypsum crystals

According to the Weather Bureau, atmospheric dust is composed of particles so small that only a few of the larger ones can be examined by the usual petrographic methods Finely divided mineral matter and loess comprise the larger part of the particles, while a few diatoms, spores, pollen, crystals of calcite and gypsum, and in winter, various products of combustion have been discovered.

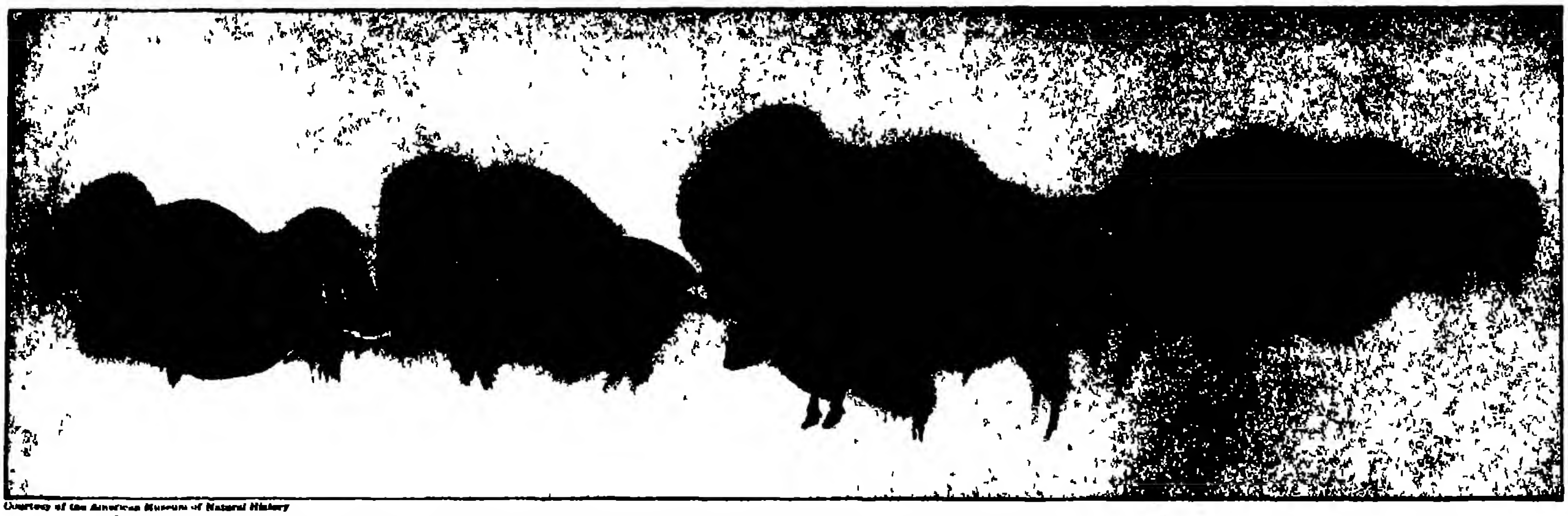
As a general rule it can be said that the average size of the particles decreases with the altitude at which they are collected The average diameter of the particles collected at the surface is about four times that of those gathered at 10,000 feet.

Can We Eliminate Dust from the Air?

Surface visibility is a poor criterion of visibility at the ordinary levels of air navigation. After leaving the ground on a morning when objects could be seen at a distance of 20 miles or more, upon reaching a height of 3,000 feet it appeared as though the plane were flying in dense smoke and the visibility decreased to 10 miles. However, generally speaking, the higher one goes, the less dust he finds. During the experiments at Bolling Field, at an altitude of 10,000 feet, the average number of dust particles per cubic centimeter was found to be less than 50, while in summer, at 6,000 feet, which is nearly to the top of the surface haze, it is about 220

Scientists have discovered that if air containing dust, fume, or smoke is subjected to a high tension intermittent direct-current discharge, particles are precipitated with varying degrees of efficiency This fact was noticed about a hundred years ago, but it received no successful commercial application until Dr F G. Cottrell, in 1911, constructed his first plant for the recovery of sulphuric acid fume

What will be the outcome of this exploration of the air in terms of actual value to aviation, navigation and science in general? As a result of Dr Kimball's and Mr Hand's investigation of the atmosphere, it is being made undeniably clear that the next step should be an attempt to rid the air of the cities to as great an extent as possible, of extraneous dust particles which we now know affect both visibility and public health Various public health services have written to Dr Kimball, asking for his cooperation in studying the dust content of the atmosphere and its effect upon public health, while aviators and navigators the world over are thankful for this boon which gives them foreknowledge of atmospheric conditions, so that in the future they will not be so dependent as heretofore upon mere winds of chance



Courtesy of the American Museum of Natural History

MURAL FRESCOES OF ANIMALS, DRAWN IN POLYCHROME ON THE WALLS OF A CAVERN IN FRANCE BY ANCIENT CRO-MAGNON ARTISTS

The colors employed by these priest-artists of 18,000 years ago were red, brown, black and yellow, and were obtained from iron ochre, oxide of manganese and other minerals

The Fossil Bones of Early Man

Man's Life on Earth Has Been Extremely Long. As We Trace It Back His Bodily Form Becomes More Primitive

By J Reid Moir

Fellow of the Royal Anthropological Institute

THERE is no doubt that, as compared with the vast number of flint implements found in ancient deposits throughout the world, the discoveries of the bones of the human beings who made these implements are exceedingly rare

It is, of course, only to be expected that his flint implements would be numerous because, in the first place, every prehistoric man must have made a great many in his lifetime—as do primitive people of the present day—and secondly, these specimens are practically indestructible, and so have survived the drastic vicissitudes of the past.

On the other hand, the comparative scarcity of ancient human bones is not a very surprising fact, since the population of early prehistoric times could not have been by any means large Further, it is probable that when an individual died, his body was left out in the open to decay, or to be eaten by carnivorous animals The fossil bones of man that are found in ancient gravel beds and other water-laid deposits, are almost certainly those of people who were drowned, or whose bodies, left lying in the open, were swept away by floods and buried in the gravel and other deposits which were then being formed. Although the precious remains of man are therefore rare, yet enough of them have been found to enable us to form a clear idea of the type of people who inhabited this earth in remote times.

A Skull Both Human and Ape-like

There cannot be any question that as we go back into the past, the type of man becomes more and more primitive, and shows an ever-increasing similarity to those of the higher apes Although the existence of man at any given period can be proved with certainty by the finding of his flint implements in the deposits of that period, yet the discovery of actual human bones is always regarded as a crowning triumph of research in prehistoric archaeology, for it sets the seal of certainty upon the previous finds of his flint implements In this article I propose to describe to you some of the more important discoveries of human fossil bones that have been made, and to show their great antiquity.

About thirty-five years ago, a remarkable discovery was made in Java by Professor Dubois, who had been sent out by the Dutch Government to explore certain deposits in that island, which were known to be very rich in the fossil bones of animals Fortunately, these researches resulted in the discovery of the upper portion of a skull, the thigh bone, and two teeth of a creature that evidently possessed both human and ape-like characteristics The discoverer of these remains gave to them the name of *Pithecanthropus erectus*, or the "erect walking man ape." There can be no doubt that this title is correct. The skull cap shows marked ape-like features—a great projecting, bony ridge over the eye sockets and an almost non existent "forehead"—while the inside capacity of the skull has been shown to be

From Moir's "The Great Flint Implements of Cromer"

AN EARLY PALEOLITHIC FLINT

This seven-pound, ten-inch implement was made in the days of the first glacial stage—500,000 years ago

intermediate between the highest apes and the lowest type of man Although the skull cap exhibits these remarkable characteristics, the thigh bone and teeth, which must be referred to the same individual, approximate very closely to those of modern man.

Thus we see that in this Javan discovery there is placed before us a creature possessing both ape-like and human resemblances The exact geological age of this fossil has been in dispute, as is often the case with the remains of ancient man, but it belongs either to the close of the Tertiary, or "third" geological period, or to the beginning of the Quaternary, or "fourth" period, and it is quite likely not far from one half million years old

Another very important find—that of a human jaw-bone in fossilized condition—was made in 1907 at Mauer, near Heidelberg, in Germany, at a depth of about 90 feet from the present surface of the ground. The geological age of this specimen is well known Judging from the nature of the animal remains found with it, it is clearly of the same period as that of the Cromer Forest Bed of Norfolk, from which I have obtained a large number of flints flaked by human hands.

Ape-like Jaw, Human Teeth

The Heidelberg, or Mauer, jaw-bone is a most impressive relic of early man. Not only is its antiquity profound, but its massive size and brutal appearance at once rivet the attention of anyone examining it. The specimen shows no sign of a chin, and the ascending rami (those portions of the jaw which branch upwards from behind the rear-most molar teeth) are of extraordinary width and strength It is obvious that the being who possessed a jaw-bone of this character must have been almost of gorilla-like proportions. In fact the jaw-bone itself, if the teeth had been missing, would have almost certainly been regarded as that of an ape But nearly all the teeth are present, and these are of a definitely human type

Thus, in the Heidelberg jaw-bone we see again a combination of human and ape-like characters.

We turn to a discovery made at Piltdown in Sussex, England, some years ago, by the late Mr.

Charles Dawson of Lewes. When visiting a shallow pit where gravel was being raised, he obtained from a workman some portions of a very thick and fossilized human skull. This important find induced him to conduct diggings in the same gravel pit, and eventually half of a lower jaw bone and a large human canine tooth were discovered. The gravel in which these remains occurred is not far from the valley of the River Ouse in Sussex, and is evidently a very ancient deposit. Unfortunately, the gravel is not of great depth, nor is it covered by any other bed which would enable us to "date" it geologically. Thus, the exact age of the Piltdown deposit, though unquestionably very ancient, is not known; but the flint implements found in the same deposit of gravel are of very early types such as we know occur in beds of the Late Tertiary and Early Quaternary periods in East Anglia

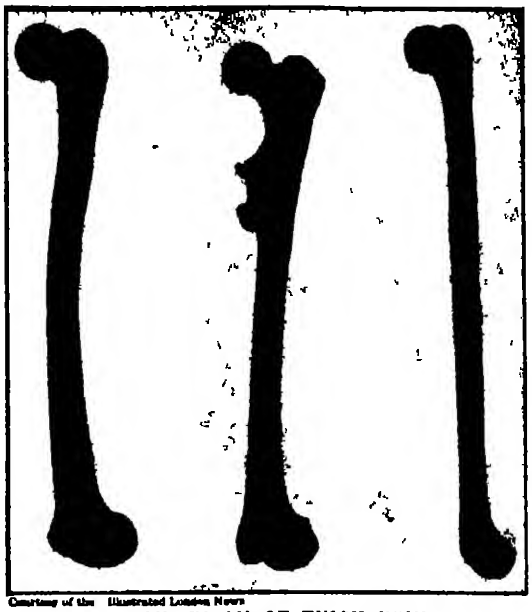
The Original "Cave Man"

The skull and jaw bone, which have been described by Dr Smith Woodward, and by Sir Arthur Keith, show us once more an individual with both human and ape-like characteristics. The skull is of definitely human form It shows no trace of the projecting ridge above the eye sockets, such as is so prominent a feature in some early types of man The bones of this skull are very thick, but otherwise in its general outline there is nothing very ape-like about it

But when we turn to the jaw-bone we see a very different picture, for it possesses many ape like characters There is the usual absence of a chin, and the whole aspect of the specimen is very primitive The most outstanding peculiarity of it is the canine teeth, which stick up above the level of the others, in the same way in which the ape's canines project Never before has a human being been known with a definitely human skull, and with jaws showing canine teeth of this kind. Thus, the Piltdown discovery is of great importance and interest to all those who are interested in man's ancestry.

It is possible that those fossil remains which I have described, namely, those of Java, Heidelberg, and Piltdown, lived during the warm climatic phase intervening between the first and second glacial phases and are possibly 500,000 years old

We must now pass on to a later epoch, when the third glacial episode or ice invasion was commencing and western Europe was peopled by a strange



Courtesy of the Illustrated London News

A COMPARISON OF THIGH BONES

Left Modern man Center Java ape-man Right Gibbon The center bone most resembles that of a man

race whose remains have been found in caves and rock shelters over a large area of country These human beings are known by the name "Neanderthal," because the first skull of this race was found in a cave in the valley of the Neander River in Germany A very great deal is known of these early people because several nearly complete skeletons of them have been found These finds clearly represent ceremonial burials—the oldest intentional interments as yet discovered

The Neanderthal race used very characteristic and well flaked flint implements, and was associated with a large number of cold loving animals whose remains have been found in the deposits of the period during which this race lived in Europe

The skulls of these people were very long and thick, and had a great bony ridge extending across the eye sockets. The Neanderthal people had massive jaws and teeth and short, thick limb bones. An examination of the leg bones of this race shows that they probably walked with a slouching gait, and from the position of the *foramen magnum* (the aperture at the base of the skull through which the spinal cord passes to the brain), it is concluded, that they carried their heads projecting forward.

So far as we know, the Neanderthal people eventually became extinct, but their bones tell human anatomists a wonderful story of one of the ancient types of man that inhabited Europe in remote prehistoric times.

Before the Neanderthal race entirely disappeared, a new and much higher type of prehistoric hunters had entered western Europe, bringing with them a hitherto unknown culture. These newcomers were remarkable people, for not only were they quite "modern" in their bodily form but they were artists of no mean ability—as the drawings, sculptures, and engravings of animals they left behind them in their old camping places, so vividly show

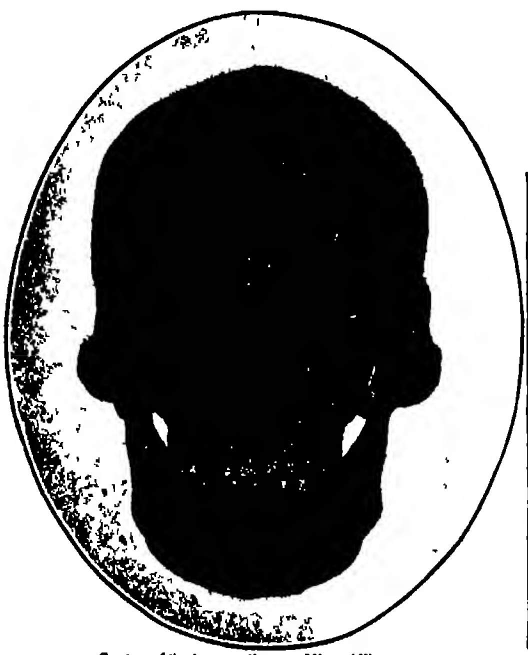
The first discovery of skeletons of this race was made in the rock shelter of Cro Magnon in France, where they had been buried It revealed a type of individual of commanding height, long headed, and with jaws and limb bones comparable to those of the highest races existing today Indeed, my friend, Sir Arthur Keith, has likened them to the Sikhs of India, while others, because of their artistic powers, have called them "the Paleolithic Greeks"

Neanderthal Man Not Our Ancestor

The origin of the Cro-Magnon people, as they are called, is somewhat obscure, but it is clear that they could not have developed from the primitive Neanderthalers Therefore, their ancestors must be looked for in pre-Neanderthal times, and it is probable that the well known Galley Hill, St Denis, and other discoveries of human bones of modern type in very ancient deposits represent these ancestors There would thus seem to be no doubt as to the great antiquity of the modern type of man of which the Cro Magnon people of about 30,000 years ago were such splendid physical examples

The fact must be emphasized that the Neanderthal race cannot be regarded as the ancestors of modern man *(Homo sapiens)* It would appear that, possibly, the cold climate conditions obtaining in Europe in middle Paleolithic times favored the sturdy Neanderthalers, and enabled them for a considerable period to dominate western Europe But, both in their physical structure and in their flint implements, they represent a very early and primitive type of mankind.

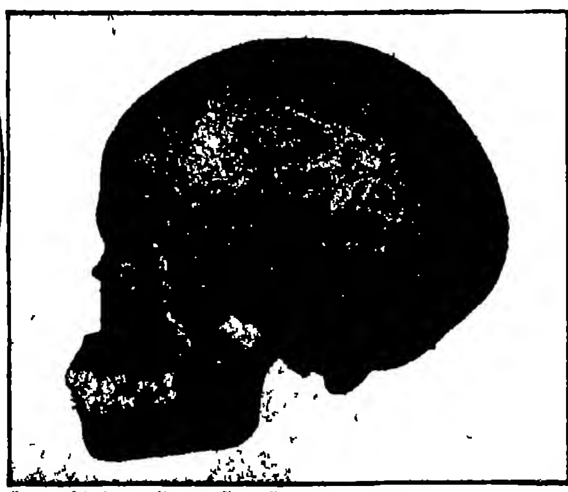
In this short survey I have mentioned merely a few of the discoveries that have been made of ancient human bones, but even this evidence is, I think, sufficient to carry conviction as to the great antiquity of man, and that, as we delve into the very remote past, we find human types becoming more and more primitive, approximating in their bodily form to that of the higher apes.



Courtesy of the American Museum of Natural History

THE "OLD MAN" OF CRO-MAGNON

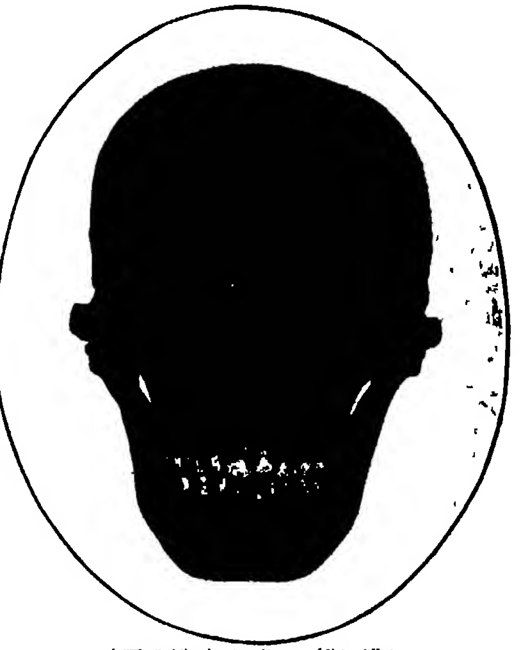
Some say there were three Cro-Magnon races—Caucasian, Mongoloid, Negroid Others claim all were one people



Courtesy of the American Museum of Natural History

GRIMALDI NEGROID YOUTH

Skull from a cave on the shores of the Mediterranean Did part of the Cro-Magnard negroids come from Africa?



Courtesy of the American Museum of Natural History

NEANDERTHAL RACE FRANCE

Neanderthal man lived both before and during the last stage of the Ice Age Cro-Magnon man exterminated him

EXCHEQUER DAM FROM THE AIR

This view was taken from one of the cables that ran 100 feet above the bed of the stream. The concrete hoisting tower at the right is the highest of its type in the world

A VIEW FROM THE MERCED RIVER

The power house is in the background and the giant hoisting tower shows beside it. The tunnel at the left is that through which trains ran until completion of the dam

Latest Lofty Dam in California

Dam, 330 Feet High, Impounds Sufficient Water to Cover 289,000 Acres One Foot Deep

EXCHEQUER dam, irrigation and power project of the Merced Irrigation District, Merced County, California, to cost 15,000,000 dollars, and said by its engineers to have been the largest work of its kind under construction in the world at the time, was completed this spring and is now storing water.

The dam, situated on the Merced River in the Sierra hills east of Merced, is 330 feet high, 960 feet long, 220 feet thick at the base, and 16 feet thick at the top, and will store 289,000 acre-feet of water. It will also make possible the generation of 42,000 horsepower of hydro-electric energy. Back of the dam a lake 12 miles long and an average of 106 feet deep is formed and approximately 91,000,000,000 gallons of water is available for irrigation and power purposes.

Exchequer dam is unique in that it is higher than seven out of eight of the great dams of the United States, and will have back of it, engineers say, the highest head of water in the world. Only one other dam in America tops it, that is Arrowrock dam on the Boise River, Idaho, which is 349 feet high.

Several other interesting claims are made for the project, among them being the use of the highest concrete hoisting tower in the world, with which the 396,000 cubic yards of concrete that went into the dam and power house were raised and placed. This tower was 475 feet high and cost the contractors no less than 500,000 dollars.

One of the distinct problems faced by engineers in the construction of the dam and power house was the fact that 17 miles of railroad of the Yosemite Valley line had to be relocated some 300 feet higher up the Merced River canyon, because the original right-of-way is now being covered by the waters of the lake. This feat alone cost the district almost 5,000,000 dollars.

Furthermore, trains which run over this line to the famous Yosemite National Park had to be kept running, so it was necessary to build the dam around and over the railroad, leaving an opening through it as work progressed and allowing the 24 trains daily to pass through the dam without interruption. The tunnel thus formed was filled as one of the last bits of work connected with the project and trains are now running over the upper and relocated line.

The following facts will give a better idea of the size of the project:

- Area of reservoir, 2,721 acres.
- Depth of water at dam, 315 feet.
- Total capacity, 91,000,000,000 gallons.
- Annual discharge of river at dam, 960,000 acre-feet.
- Excavation for foundations of dam, 97,000 cubic yards.
- Total concrete, 396,000 cubic yards.
- Radius of arch of dam, 675 feet.
- Weight of penstock and sluice pipes, 622,000 pounds.
- Weight of valves and gates, 1,100,000 pounds.

The valves and gates for regulating the flow of water include two 48 by 60 inch high pressure slide gates, two 75 by 96-inch high pressure slide gates, two 96-inch inlet diameter penstock valves, two 96-inch inlet diameter, free discharge needle-type valves, and two 60-inch, inlet diameter, free discharge needle-type valves.

PARTIALLY COMPLETED BRIDGE

This bridge, 1,600 feet long and 236 feet high, was built for the relocated Yosemite Valley Railroad

Spillways for the dam are of the overpour type into concrete channels, with a crest length of 336 feet and a capacity of 75,000 second-feet of water.

Power house equipment is as follows: Two 15,625 kilowatt 11,450 volt three phase, 60 cycle, 257 revolutions-per-minute generators, with a maximum capacity for the plant of 42,000 horsepower using 1,500 second feet and two variable head, cast-steel case, 257 revolutions-per-minute turbine water wheels.

The power house output annually is 120,000,000 kilowatt hours which the district has already contracted to sell to a California power corporation for 1½ mills per kilowatt-hour or about 540,000 dollars a year.

While construction work on the dam and power house proper was completed on schedule, completion of the entire project was delayed somewhat by the relocation of the railroad.

Owing to the fact that the project is in mountainous country, the relocation of the railroad necessitated the movement of almost 2,000,000 cubic yards of rock and earth, the drilling of four tunnels, one of them a quarter of a mile long, and the construction of three steel bridges, one of them 1,600 feet long and 236 feet high.

This table shows how Exchequer dam compares in size and cost with some of the other big dams of America:

Dam	*Height*	*Length*	*Cost*
Exchequer ..	330	961	$15,000,000*
Don Pedro	283	1,040	4,000,000
Roosevelt ..	280	1,125	4,091,000
Arrowrock ..	349	1,100	4,497,000
Elephant Butte	306	1,674	5,000,000
Shoshone ...	328	200	1,671,000
Kensico .	307	1,825	15,171,000
Keokuk	53	4,360	24,000,000

* Includes relocating railroad.

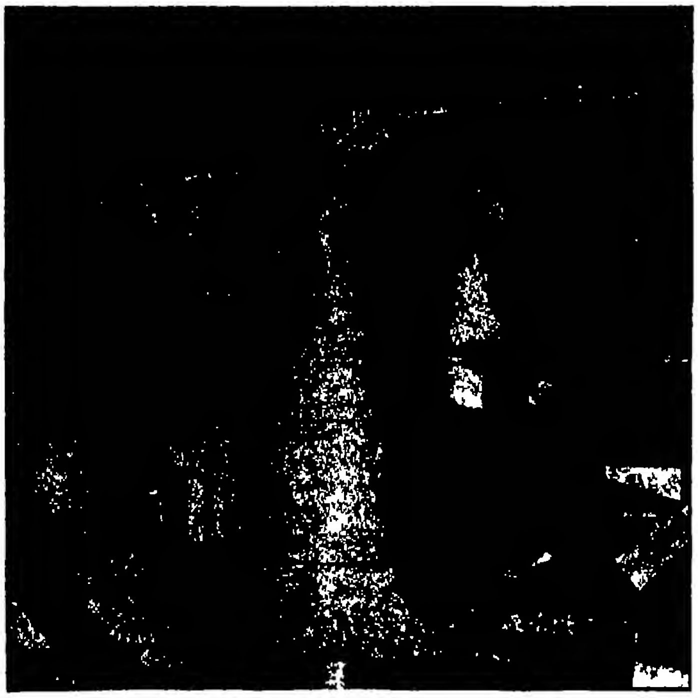
The District of Columbia has one of the few municipal garbage disposal plants that is run at a profit. How the refuse is turned into salable oils and greases is an interesting story that will be told in an early issue.

THE MOVABLE TENSION CROSS-HEAD

This cross-head is equipped with grips for holding the specimen which is being tested in tension. This cross-head moves slowly away from the reader, being driven by a powerful hydraulic ram which pulls on the specimen

SNAPPING BIG STEEL CABLES LIKE THREAD

The editors of The Engineer *inspected the machine and saw it break a wire rope 2¾ inches in diameter, under 240 tons tension. But this was mere child's play for the great machine*



SHACKLE WHICH TAKES THE WHOLE STRESS

If the specimen under test suddenly gives way there is a considerable recoil due to the elasticity of the various parts of the machine. In designing the shackle this point had to be considered in order to avoid disastrous results

THE MAMMOTH MACHINE AS A WHOLE

Its overall length is 120 feet and it stands 11½ feet above floor level. It will take specimens up to fifty feet long and 12 inches by 3 inches cross section for tension members and up to 45 by 15 inches for compression. For transverse bending the maximum span is 20 feet

Giant Testing Machine Pulls 2,800,000 Pounds

A huge testing machine capable of exerting a force of 1,250 long tons has just been completed in Birmingham, England, primarily for testing parts of the immense arch bridge of 1,500 feet span that is now being built across the harbor of Sydney, in Australia. Our British contemporary, *The Engineer*, states (July 30, 1926) that "from time to time efforts have been made in America to test to destruction full sized members of bridges and other structures, with the object of verifying the designer's calculations, but, so far as we are aware, the apparatus used in these tests was rather crude and neither allowed of a graduated load nor of a precise determination of its magnitude. There is, however," *The Engineer* continues, "now in this country a machine capable of performing all the tests required by a bridge designer with great exactitude and convenience." Does the above statement not stand as a challenge to American engineering? The new machine is said to be easily the largest of its kind, capable of pulling apart a steel bar over six inches in diameter. The required tension and compression stresses are applied by means of a hydraulic ram 32 inches in diameter with a stroke of 66 inches. To this ram water is supplied at a pressure of up to two tons per square inch. Since the most important lessons to be gained from the testing of large specimens for various structures such as bridge girders, posts, tie rods and so on result from their actual observation and study while undergoing gradual destructive test, the machine was built horizontally instead of vertically. Hence, a clear view of the test specimen may be had at all times. The amount of the load is measured by means of a steelyard at one end. The full stress of 1,250 tons (presumably the long ton of 2,240 pounds usually employed in Great Britain) is carried by the massive shackle shown above. It must be measured with a high degree of accuracy, large as it is. It is therefore balanced against a weight of one ton on the steelyard, the ratio of leverage being 1 to 1,250. As the loading of the knife edge must be kept within the limit of five tons per lineal inch (if the edges are to remain edges), it is obvious that the edge would have to be 20 feet long! Since so long an edge would be impracticable the load is divided between four levers.

Classifying the Arthropod

This Sub-division of Animals That Have No Bones Makes an Interesting Subject for the Nature Student

By S F. Aaron

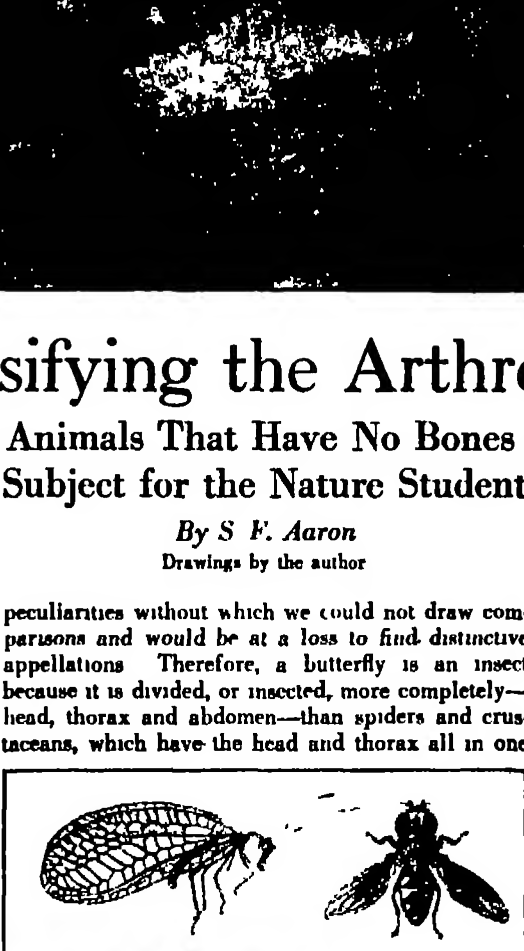
Drawings by the author

IT would be an aid to nature study if the term "arthropod" were as commonly used, as familiarly accepted and as well understood as the words insect or spider, reptile or bird.

The definition of arthropod is as easily comprehended as any term that refers to a group of animals or plants. It includes all that largest sub-kingdom of organic creatures that have a segmented exoskeleton and locomotory appendages. In other words, they are the animals that are without a backbone or any bones at all, strictly speaking, their bodies being encased in a ringed, exterior tegument and having legs and, sometimes, wings. In this great division is included the crabs, lobsters and shrimps as one class, the spiders, mites and scorpions as another, the millepedes and centipedes as the least numerous group and the insects which in numbers of distinct forms or species exceed all other animals and plants combined.

Thus the arthropods, considering their varied and extensive development, comprise the largest branch of the evolutionary tree, springing most probably from the ancestral forms of the annelids, or true worms, the latter falling far behind in the effort to meet successfully the widely different and changing influences of environment.

There are more extreme differences in the forms, habits and behavior of the arthropods than are to be found in any other division of the animal kingdom of equal importance, as the classificationists see it. Without giving much attention to the narrow distinctions of the systematists, it is nevertheless essential that we understand those major variations and peculiarities without which we could not draw comparisons and would be at a loss to find distinctive appellations. Therefore, a butterfly is an insect because it is divided, or insected, more completely—head, thorax and abdomen—than spiders and crustaceans, which have the head and thorax all in one and only the abdomen attached by a stem. The millepedes have merely a series of even rings and are therefore more distinct.



COMPARISON OF MUSCLE AND WING STRUCTURE

The insects on the left, the golden-eyed fly, ant-lion fly and swallow-tailed butterfly, are among the weakest aerial performers. Those on the right, the bee fly, robber fly and noctuid moth of the army worm are among the swiftest of all winged creatures

The spiders show less variation than all other groups, they are all carnivorous, are the most agile of all arthropods and the least affected by cold, though possessing a low vitality from direct injury. A pin may be thrust through the body of a butterfly and withdrawn and the creature apparently suffers little inconvenience beyond an occasional, temporary muscular constriction. Even with the pin left in place, the highly organized insect will enjoy a repast of flower nectar. Thrust a pin into a spider only a little way and the creature dies immediately. The nervous and sensitive organism of arthropods prevents them from experiencing actual pain, as is also true of the lower forms of the vertebrates.

The eyes of the arthropods have become a means of classification. Because of their great variation and complicated development in many forms, it might seem that they had also reached a high state of optic perfection, as is the case with the eyes of cats, certain rodents and many birds. But this is not so. The range of vision is never over ten feet, generally much less than that and often but a few inches. Although the observation of movement, commonly by the reflection of light, is of great use in determining the attack of an enemy, or more rarely, the swift presence of a mate, there is almost a total lack of recognition of form, as may be frequently noted. A winged insect will alight on any stationary object—a butterfly net, the collector's hand, the head of a snake or within a few inches of an insect-eating bird. Bright contrasts of color are

discerned, as is also reflected light when not moving, but for the most part, the true nature of nearly all objects is made known by odors. It would thus appear that the ability to detect with astonishing accuracy the most delicate odors, and these at long distances, has become a more easily effected matter of extreme development than a discriminative optic nerve; yet this is the more strange when the differences of transmission between rays of reflected light and odoriferous particles are considered, the latter depending largely upon the wind. It is not only and chiefly a matter of discrimination, but one of comparative sensitiveness. Certain sexual odors bring winged insects for miles, while the extreme attractiveness of artificial light has a very limited range. These facts are fully proved.

A simple experiment is the placing of a brightly colored imitation flower among actual blossoms, the colors not necessarily agreeing. Many nectar-seeking insects, notably the butterflies and bee-flies, will visit it, though remaining only a fraction of a second. Thus the bright hues of flowers contrasting with the foliage do aid, although in a minor way, to guide insects to them for purposes of fertilization, yet all these lovers of sweets are even more eager to visit molasses smeared on tree trunks and the dripping of honey-dew than to seek the most delectable and brightly colored flowers.

Although showing considerable variation, being thread-like, clubbed, pectinate, feather-formed or branched, the antennas of the arthropods, which are almost their sole means of detecting odors and of determining the direction from which they emanate, are not of class distinction, but give character to orders and families of nearly all groups. Legs, and the thorax supported by them, constitute the chief differences of major value in identifying the four classes of the arthropods: the Crustacea and Arachnida, having eight legs attached to a cephalothorax, the Millepedes, having almost as many legs as the numerous body rings which include the thoracic and

SEVERAL FORMS OF ARTHROPODS

TOP. *A lace-winged bug, one of the extremes of exoskeleton forms, much enlarged.* LEFT CENTER: *A mite, one of the simplest of arthropods, greatly enlarged. The mite is of the spider class.* RIGHT CENTER: *A springtail, one of the simplest of the true insects. Shown about four times natural size.* CENTER: *A parasitic wasp, in life no larger than a pin head.* LOWER: *A digger wasp, natural size*

abdominal organs, and the insects with but six legs—whence the name Hexapoda. The latter constitutes the only class that possesses wings, although there are many apterous forms.

There is little variation in the general construction of arthropod legs, all consist of five distinct parts, but the tarsi, generally of five joints also, are, in the simpler forms, of two and three joints. Length and relative size as denoting strength are the chief differences. Running speed bears little respect to number or size, but for leaping, the femora are always thickened for the additional muscular development.

"Thousand-legger" Has Only 220 Legs

The terms centipede and millipede are, of course, extreme exaggerations, the former group of entirely carnivorous forms are rapid-running and possess commonly from twenty-six to forty-two legs. The "thousand leggers" have as many as 220 legs, two pairs operating from each of the body segments, with the exception of the three posterior rings. These creatures are slow of motion and vegetarian. Allied to these are the sow or pill bugs, so called, which have 14 legs attached to the thoracic rings.

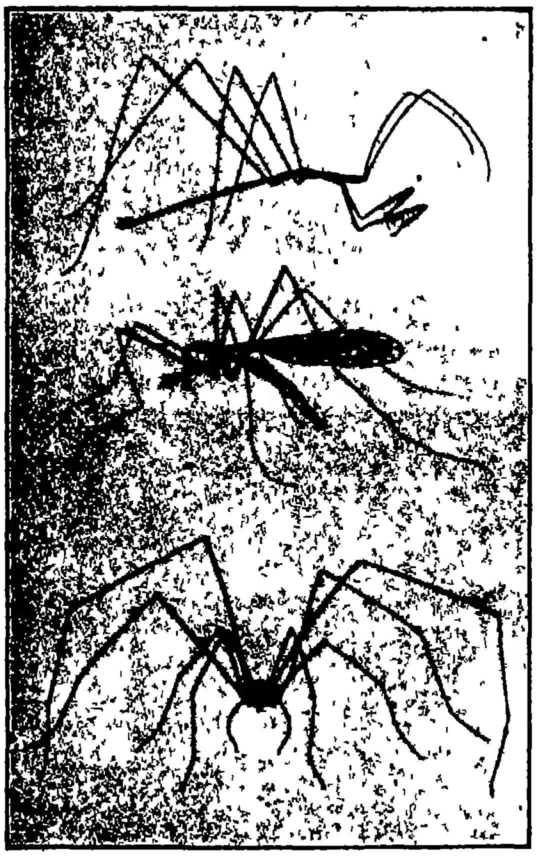
Extreme length of legs is of importance as a means of protection against savage, shorter-legged enemies, or, in predacious forms, as a sort of encompassing cage to prevent the escape of smaller prey. Thus, "daddy-long-legs" (pedipalpi), in making ready to pounce upon a leaf beetle or lethargic fly, surrounds it with drawn-in legs and then swiftly lowers its body upon the victim.

The number, shape, size and venation of the wings are factors governing the classification of the insects. Invariably the relative power is governed by the muscular development in proportion to the wing area. Thus, all the swift-flying species have stout bodies and small wings, while nearly all the slow or indifferent fliers, among the latter being those that merely support themselves in air and drift with the breeze, are forms with slender bodies and comparatively large wings. There are some exceptions among the heavy-bodied forms, as notably the plant lice which have their muscles crowded out by the digestive and genital organs. Also, some beetles are endowed only with great leg power. Among the butterflies, the geometrid moths and the true Neuroptera, there are large-winged species that have also great muscular power, enabling them to fly moderately fast, with excellent control.

Size in general is of little importance with regard to the characteristic form or habits of any species. Certain families of all the classes are all very small or quite gigantic, others possess genera and species of both extremes. We are inclined to regard those forms demanding the use of the microscope as possessing simple organisms, finding this in the protozoa and in such vegetation as the bacteria. Among the Crustacea and Millepedes there are none that are exceedingly minute, except when hatched out, but the insects possess many forms that are microscopic in all orders and the mites belong to the Arachnida.

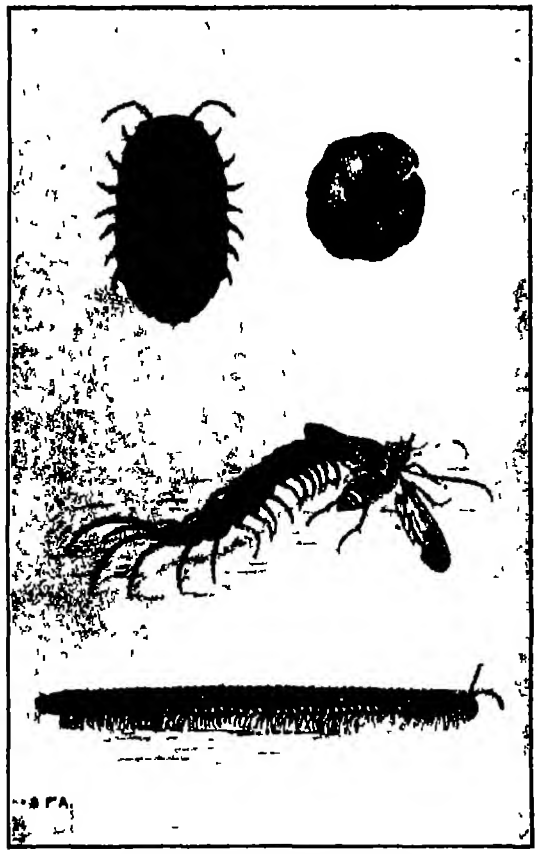
We are also prone to regard microscopic creatures as relatively simple with regard to mentality. It almost seems, at first thought, as though choice, memory, recognition of circumstances and attendant mental processes that are shown by many of the more highly developed insects would require a brain large enough to receive and record these complex impressions. However, the most minute Hymenoptera and Diptera are not only similarly constructed physically throughout, but also show habits similar to and as remarkably complex as closely related forms a hundred times larger. Thus the tiny wasps, no larger than a pinhead and that are parasitic on aphids and spider eggs, might be compared in size with the big ichneumon wasps, like a shrew unto an elephant.

¶ *One of the unrivaled "wonders of the commonplace" is the tiny snow crystal, too fine in detail to be seen unaided. By a painstaking technique, these have been photomicrographed. The method used for this work and results obtained will be described in our December issue.*



LONG-LEGGED INSECTS

TOP: *A stilt bug.* CENTER: *A giant crane fly.* LOWER: *A pedipalpi, commonly known as "daddy-long-legs." This insect surrounds and holds its prey with its long legs and then proceeds to kill it. Illustrations about full size*



MULTI-LEGGED ARTHROPODS

TOP: *Wood-louse or pill bug (not a bug at all), that rolls itself up like an armadillo. Its technical name is Armadillidium.* CENTER: *Woodland centipede killing a bee fly.* LOWER: *Millepede or so-called "thousand legger"*

FIGURES 1 TO 4: CLOSE-UP VIEWS OF THE EYE WHEN UNDERGOING TESTS

When Reading, Your Eyes Move in Jumps

Tests With Chinese Characters in Vertical and Horizontal Lines Disclose Some Remarkable Facts About the Movements of the Eyeball

By Professor Walter Miles, Ph.D.
Psychology Laboratories, Stanford University

SOME ancient Chinese as he sat reading with his fingertips resting lightly about his eyes and on his forehead, may have noticed, through the sense of touch, the peculiar jerking motion of the eyes as he scanned a line of characters. Considering the fact that the eyelids follow the movements of the eyeballs, promptly responding as the line of vision is raised or lowered, the reading of symbols arranged along a vertical line would offer a good opportunity for making this observation.

Chinese characters have traditionally been arranged in vertical lines to be read from top to bottom, starting in the upper right hand corner of the page, and proceeding with successive lines to the left. But so far as our scientific world is aware, no Chinese, and we may say also, no Egyptian, Greek or barbarian, ever recorded the fact that the eye goes in little jumps when reading.

It remained for Professor Javal of the University of Paris to discover, in 1879, that the passage of the eyes along a line of print is not a continuous movement. He used no elaborate apparatus, simply direct observation aided only by a mirror. Now that attention has been drawn to the phenomenon, anyone can easily verify the fact of the discontinuous movement by closely watching a person who is reading. It is more difficult to detect in one's self but this can be done by careful observation.

Discontinuous movement is the typical behavior of the eyes in the individual who, walking or quietly talking with a companion, looks out upon his environment. The eye moves and pauses, moves and pauses, alternately flitting and perching like a bird in a bush. The movements are not of the same size, and may be in any axial direction. Winking, for moistening the eyeball and generally "servicing" it, commonly occurs during the movement phase. Often there is the further complication of an associated head movement.

If we think of the eye as a camera and if there are to be clear images on the retina, it must have moments of stationary position. Blurred images would result at the time of movement unless the object of vision and the eyes moved at a corresponding rate. A chicken or a pigeon that is walking is observed to move the head in a jerking manner. By so doing, moments of stationary position are secured for the eyes, with the result that relatively unblurred vision is obtained while the body is continuously moving. The pauses of the human eyes are really quite brief, but "mere glances" though they be, they constitute the real times of "seeing" and have much greater duration than have the movement phases. The method of proving this is described below.

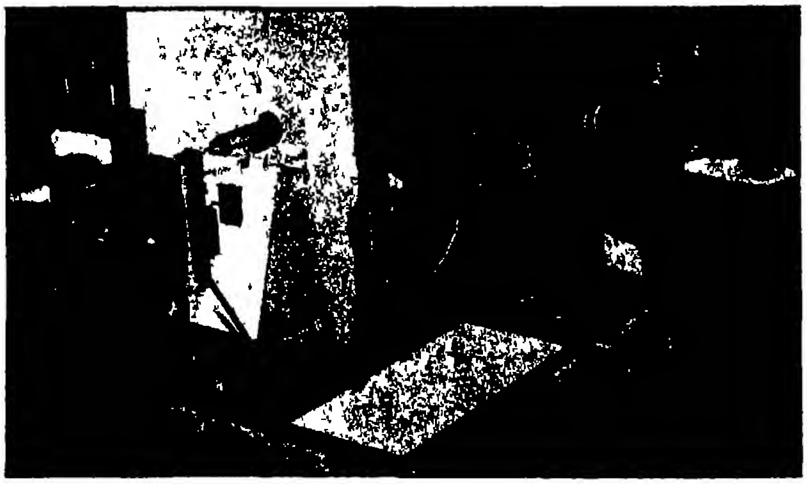
Chinese a "Two-dimensional" Language

Perhaps it has always been implicitly assumed that the eyes perform discontinuous movement in reading as in all other observing of stationary objects. Professor Javal's discovery was, however, not limited merely to establishing this point. His work was of importance because it revealed the characteristics of mental perception. He found that the number of pauses in reading a line was not very great—only about half as many as there were words in the line. This was a discovery indeed. According to this individual, letters were not seen as such, words and even groups of words were grasped as wholes.

This field of inquiry, once opened up, was entered by a number of investigators, and has been chiefly worked by Americans. Tracing levers were devised to be attached directly to one eye by means of plaster of Paris or ivory cups. These devices gave permanent records on smoked paper, but had their disadvantages, not to mention dangers, to those who served as subjects. Photography offered the most practical means of recording. Motion pictures were tried and were quite effective in some laboratories, notably at Yale. But the measuring of the photographs in the successive frames of the motion picture for plotting the results were very tedious.

Professor Raymond Dodge, working at Wesleyan University, originated a technique of photographing on a continuously moving film. He illuminated the eye with an arc lamp placed at some distance, and took advantage of the fact that the bright image of the lamp reflected in the eye shifts position with each eye movement, because the cornea has a different curvature from the eyeball and protrudes slightly. This technique is now commonly in use and is the one which we are employing at Stanford University. By this method, the reading of English has been extensively studied, and some European languages also have been carefully examined with interesting results.

Chinese is radically different from those languages that have been studied in this manner. It is arranged in the vertical axis. It is not based upon phonetic spelling. Its characters are all essentially perfect



CAMERA FOR RECORDING EYE MOVEMENTS

FIGURE 9. *To the extreme right, in the photograph above, are shown the arc lamp and the motor for interrupting the light and making time measurements possible*

ONE OF THE SUBJECTS UNDER TEST

FIGURE 10. *Notice the two small mirrors that reflect the light to the eye of the subject, and make it unnecessary for him to look directly at the source of illumination*

Figures 5 to 8: More Eye Views. See the Description in the Text

squares so that it may be termed a "two-dimensional" language. Of these the simplest form is a horizontal line, while other characters look like complicated windows of lattice-work and each character may contain more than thirty strokes. It is quite natural to ask whether Chinese is read with the same sort of eye movements as are used for English, whether the eye stops on each character or perhaps even wanders about within complicated characters. The recent investigation by Mr. Eugene Shen and the author is the first study of its kind on Chinese.[1]

The photographs of the eye which accompany this article are for demonstrating just how it is that the bright image of the lamp reflected on the cornea shifts with the movements of the eye and may thus be photographed to give a record of eye movements. These photographs were taken, in each instance, with the film stationary as in an ordinary camera. In Figures 1 and 2, the subject, a Chinese, tried to look steadily at a white pinhead for four seconds while the film was exposed. He succeeded in Figure 1, but in Figure 2 the bright dot on the black corneal area is doubled, showing that his eye moved.

Horizontal eye movements, voluntarily performed, are recorded in Figures 3, 4 and 5. He looked at one pinhead for two seconds and then, with the shutter of the camera still open, shifted his gaze directly to another pin located on the horizontal, 40 degrees distant, and held this position for two seconds. This, at least, is what he was asked to do and what he thought he did. But the white dots on the photographs show that the eye paused at other places. The faint white streaks indicate the paths of movement. Similar tests of 40 degree eye movements made in the vertical are shown in Figures 6, 7 and 8. Here it is likewise seen that the fixations of the pinheads are not perfect and continuous, and also that the path of movement is not actually vertical.

In Figures 3 to 8, inclusive, a spectacle frame carrying a bright metal bead was worn. The reflection from the bead indicates the method of recording possible head movements. Taking Figure 5 as an example, if in place of the stationary film used to take this photograph we had employed a strip of film moving continuously in a vertical direction, each white dot would have registered as a vertical line connected by short, nearly horizontal, lines to other verticals. The whole succession of positions and their relative durations would have been directly plotted and we would have a record of the same nature as Figure 12, but in this case not a reading record.

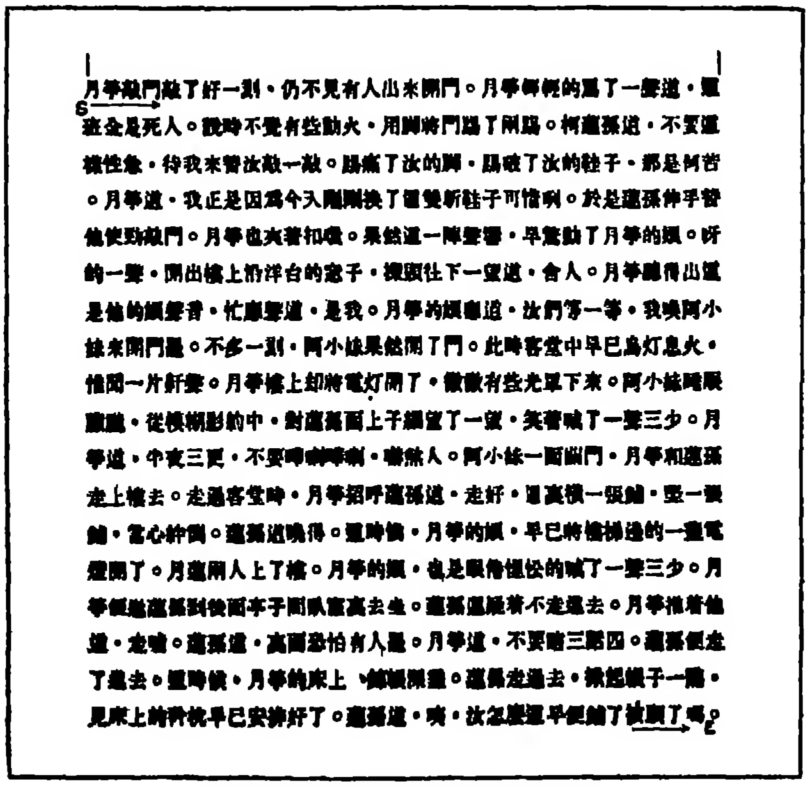
How the Records Were Made

The arrangements of the special photographic equipment are evident from Figures 9 and 10. This is a compact and somewhat modified form of the Dodge type of eye movement apparatus. The arc lamp and the timing motor, for interrupting the light and thus giving time values to the reading record, are shown at the extreme right in Figure 9. The adjustable head rest (a support for the fore-head and a biting board) are at the left in the picture. The copyholder is directly in front of this, and just above the copy the lens may be seen extending from the long hood of the enlarging camera. Two small, first surface mirrors near the subject, (see Figure 10), reflect the light from the arc to his right eye, but from one side so that he need not see the light directly.

The entire eye and adjoining area is, of course, illuminated, but the camera is focused only on the bright light which is reflected from the cornea. Nothing but the movements of this bright spot will record in the subdued blue light that is produced by using filters in front of the arc. The copy is illuminated by a reading lamp with a rather strong yellow light. The film may be moved in the vertical or the horizontal by a spring motor unit mounted at the far end of the hood. The camera provides a five-times magnification. The adjustments are simple and direct and the apparatus may readily serve for recording eye movements under a variety of conditions. A feature that is of particular value is that the page of copy exposed at one time may be quite large.

The specimens of copy to be read, and illustrated in Figure 11, left and right parts, are reduced for reproduction in this article. The squares of text in reality measure six by six inches. Both parts, in this case, contain exactly the same reading material. In the right section it is printed in the vertical as Chinese is traditionally arranged on the page. This would be read by starting at the upper right hand corner (at S on the illustration) and

[1] W. R. Miles and Eugene Shen. Photographic recording of eye movements in the reading of Chinese in vertical and horizontal axes: Method and preliminary results. Journal of Experimental Psychology, 1925, Vol. 8, pp. 344-362.



CHINESE WRITING IN ENGLISH STYLE

Figure 11, Left. *A section of copy, printed in horizontal lines, that was used in making the photographic eye-movement records*

CHINESE WRITING IN CHINESE STYLE

Figure 11, Right. *In this piece of copy, the characters are arranged in traditional Chinese form, to be read in vertical lines*

RECORD OF THE EYE MOVEMENTS WHEN READING CHINESE

FIGURE 12 *The lower of the two tracings is a record obtained when the subject was reading vertical Chinese. The upper one shows the results when the subject was made to read Chinese characters arranged horizontally See Figure 11 for styles*

continuing in the direction of the arrow, reading successive lines from top to bottom until reaching the end at *E*

In the left section of Figure 11, the same text is printed in the horizontal arrangement that is typical of English, reading from left to right As the Chinese characters are squares, they may readily be placed in either axial line At present some Chinese scientific journals are printed in the horizontal This has the practical advantage of making it more simple to include quotations or names from English and European languages and such things as mathematical formulas.

The illustrative record, Figure 12, of eye movements made in reading, is a combination resulting from reading a page of vertical text and a page of horizontal text. The content of the two pages was, of course, not the same The camera was turned 90 degrees, between readings, so as to have the film moved at right angles to the direction of reading in each case The film was thus run through the camera twice. Our ordinary records are made in this manner, photographing two or more reading tests side by side on a film two and a half or three inches wide The faint white line at the top is from the light reflected by the metal bead on the spectacle frame and indicates that the head was held quite still during the test.

The Time of Eye Movements

The large movements at the beginning of the record, left end, are not reading movements, but are preliminary The subject looked back and forth at two dots or short black lines placed one at each end of the initial line of copy A white screen at first covered the copy, but left these dots exposed The size of the movements made in looking at the dots could be compared with the later movements when looking from the end of one line to the start of the next, as the subject read the copy after the screen had dropped When the subject gets well launched in the reading, the swift movements made between lines are found to be smaller than the preliminary fixation movements This indicates that the eye does not actually look to the end of the line nor does it start at the very beginning The difference in the size of these movements for horizontal and vertical reading (upper and lower tracings in Figure 12) is noteworthy as the length of printed line was in this case the same This difference is due to a forward shift in the center of rotation of the eyeball when the eye executes vertical movements so that the cornea is not actually displaced as far

The reading record looks somewhat like a succession of low pitched flights of stairs. Each flight corresponds to the reading of one line. Evidently the record is complete for eight lines of horizontal text and nearly so for eight lines of vertical copy Proceeding from the left, if we count the "treads" rather than the "risers," we shall find the number of eye pauses to be seven to nine per line, whereas there are 28 characters in a line The duration of the pauses is quite variable In the reproduced photograph we cannot count the fine white dots, each representing 1/50 second, which make up the record, except where these have been stretched out due to the swift move of the eye between lines. The little gaps in the lines of white dots are 1/5 of a second apart From these we can see that the pauses are seldom as short as 1/5 and never, in these tracings, as long as 4/5 of a second Reading the first line of horizontal characters required 3 6 seconds, and very nearly the same total time value is found for the first line of vertical copy

Data were collected from the reading of four selections, two vertical and two horizontal, by each of 11 subjects, all Chinese students at Stanford University In this case each selection was a complete paragraph containing 10 to 12 lines A full vertical column was 6¾ inches in length with 35 characters, and the horizontal line was 5½ inches long with 23 characters. The characters were of the same size for both alinements. The subjects were instructed to read silently and understandingly Comprehension was tested by questions in order to make the experiments entirely free from inaccuracies due to the skipping of words.

It was found that the average reading pause for both vertical and horizontal material was about 0 3 seconds, tending to be slightly longer for the vertical. A more consistent difference between reading in the two axes is shown in the average number of words covered by one reading pause, which ranged with the different men from 1 0 to 3 3 words. For the vertical selections, the eleven Chinese averaged 2.3 words per pause of the eye, as compared with 1 9 words in horizontal reading The results may be stated in terms of speed of reading as average number of words per second of time. Here the range is from 2.9 to 11 0, averaging 7 3 for the vertical and but 6 2 words per second for the horizontal

A short pause and a long span result in rapid reading, while a long pause and a short span means slow reading rate. The vertical text shows slightly longer duration of reading pauses, but each covers a greater number of words. As a result, the vertical has some advantage in reading speed as found by these highly interesting experiments at Stanford University

Of course, it cannot be demonstrated that the 11 Chinese used in the test have exactly equal practice in both horizontal and vertical reading They had all of them read horizontal Chinese since childhood in various books and journals and were well practiced in reading English and, in some cases, other horizontal languages, so they considered themselves well practiced in horizontal reading. In the texts used, the content seemed to be of equal difficulty, the characters were of exactly the same size and type face and the spacing was closely the same. The horizontal lines were shorter in these texts used in our first experiments However, from the extensive work with English, it is well known that a short line is read with relatively greater speed, hence the horizontal texts in our experiments really had some advantage over the vertical copy. More elaborate and extended experiments by Mr Shen, as yet unpublished, on strictly comparable texts bear out these first results.

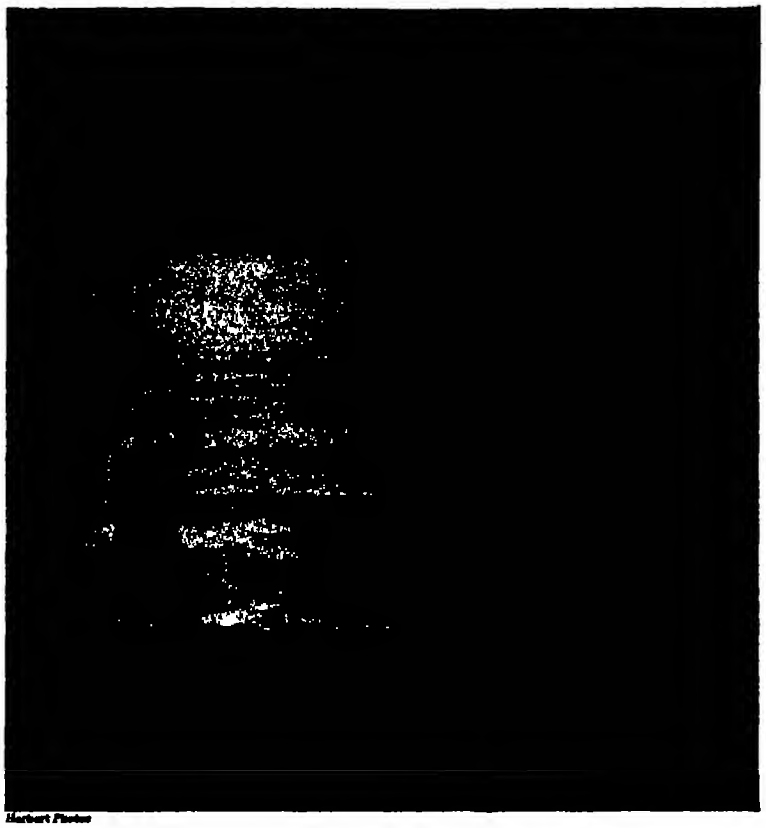
Vertical Reading Less Tiring

Our inquiry has therefore disclosed the fact that the process of reading Chinese is fundamentally the same as for reading English Each line of print, whether in the vertical or horizontal, is covered by a series of quick movements and much longer pauses. At each pause, more than one character usually is read. While Chinese is condensed and what might be called a two-dimensional language, still the eye moves in essentially a straight line and does not wander about, even in complex characters.

It is surely interesting to find that vertical reading has an advantage over horizontal. We hardly dare speculate on why the ancient Chinese adopted the vertical. Possibly the coordination of moving the eyes along a vertical line, when they are focused at the proper distance, is the simpler and, in the long run, less tiring. At least we know now that the eyes of a Chinese, regardless of the position of the superficial tissue which surrounds them, behave just like those of a European. Related questions must await the progress of research.

CONTINUATION OF THE RECORD AT THE TOP OF THIS PAGE

Considering the two tracings as a whole, each set of "stair steps" corresponds to the reading of a single line of 28 characters. Counting the "treads" rather than the "risers" gives the number of reading pauses made by the eye of the subject



Herbert Photos

THE CEYLON PEARL FISHER'S FLEET

At sunset the picturesque pearl fishers' craft wend their way homeward bearing the day's harvest of pearl oysters. Perhaps there is less than a cupful of pearls in the entire fleet

Herbert Photos

BARTERING FOR PEARLS WITH THE DIVERS

As compensation for their risky work, the divers receive one-third of their finds—provided they are not cheated. These, as a rule, they sell to retail purchasers who line the shore

Herbert Photos

ALL SHOWS BUT THE SMELL

The oysters are piled in a canoe and left to rot in the sun for a week. From the resulting mass of smelly slime the natives knead out the tiny pearls with their hands

Herbert Photos

DRILLING PEARLS IN CEYLON

With his simple bow drill, the driller can pierce forty to fifty pearls a day, thus permitting them to be strung in ropes

Herbert Photos

RETAILERS HUNTING FOR PEARLS

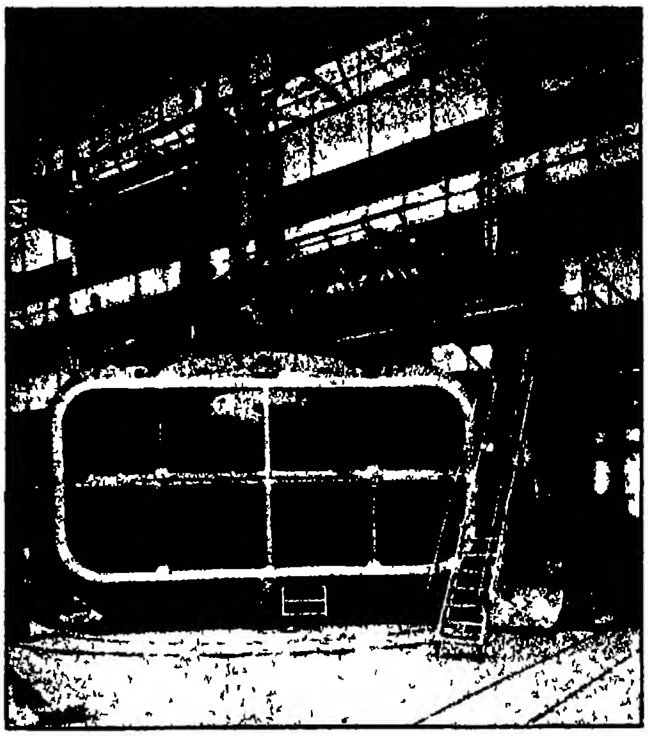
It is extremely hard to see or feel a pearl in a fresh oyster. Therefore it is the practice to await decomposition before the search begins. The reader may imagine the smell

The Romantic Quest of the Iridescent Pearl

Paying a fortune for an optical illusion is what one does when he buys a rope of pearls. The inimitable iridescence of the genuine pearl is due simply to the existence of microscopic corrugations on its surface, spaced about one fifty-thousandth of an inch apart. They produce the colorful optical effect known to the physicist as interference fringes. To demonstrate that the charm of the pearl is only a surface effect let the outer layer of one be peeled off: the pretty gem will become a dull, uninteresting pebble of limestone. What a costly experiment to demonstrate a natural truth! Pearls are found in shallow seas over a large part of the Orient. For thousands of years, among many peoples, they have possessed a religious significance, while there are many who believe it was the romantic world wide quest for pearls which led to the diffusion of early civilization from some near Mediterranean center to the east, and ultimately across the broad Pacific. Pearls abound near the isles of that misnamed ocean and their quest provides a large part of the living of the islanders. Many a true romance has been written around the adventurous lives of pearl dealers in the Persian Gulf, India, Ceylon, the Spice Islands, and Australia. But these are not the men who find the pearls. The native, accustomed to the water from boyhood, becomes almost a human fish. As a diver, he generally remains under water from fifty to eighty seconds

100,000 GALLONS OF WATER PER MINUTE

Nearly 100,000 gallons of water coming to the condenser through six foot, cast-iron pipes will flow through the condenser each minute More than 40 miles of brass pipe, with a total surface of over one acre, will condense the exhaust steam from one of the 60,000-kilowatt turbines

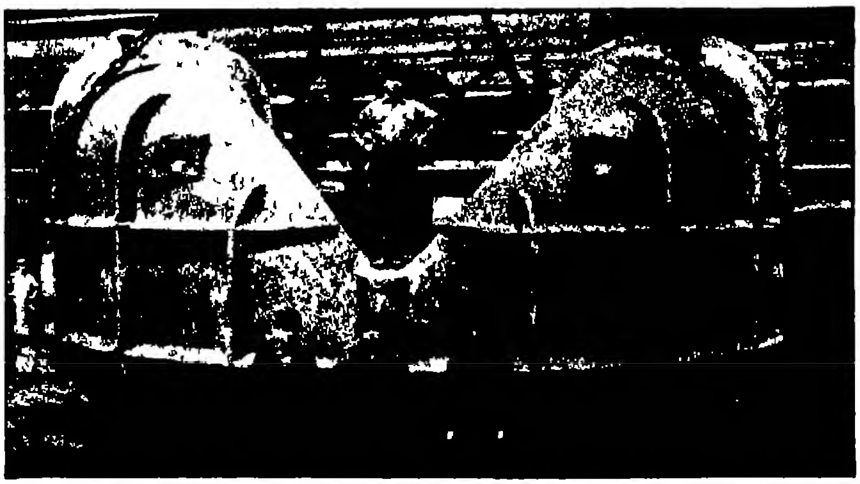


BORING OUT THE EXHAUST HOOD

Boring out an enormous casting for the lower half of one of the turbine exhaust hoods for the new million-horsepower generating station Although a comparatively small volume of high pressure steam enters the turbine, its expansion is so great that a huge exhaust hood is necessary to carry low-pressure steam to the condenser

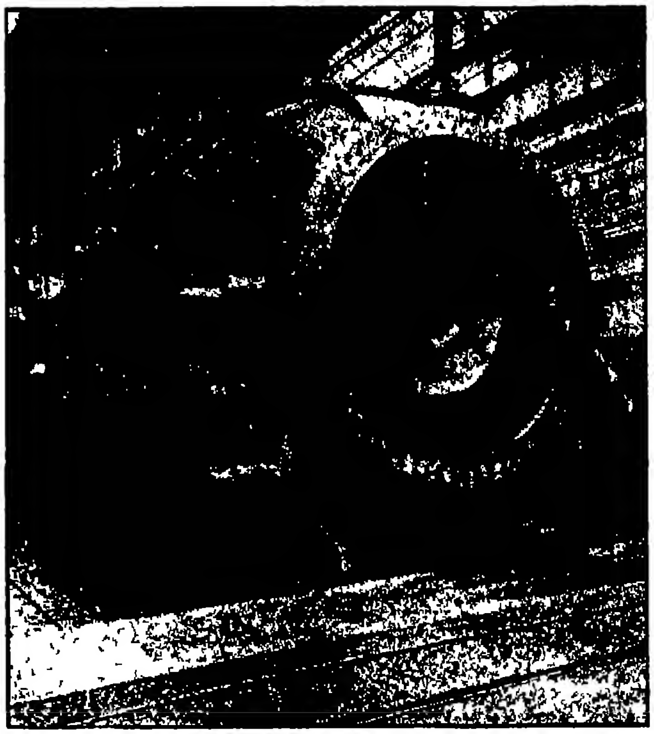
ROTOR OF A 40,000 KILOWATT FREQUENCY CHANGER

This big wheel, 13 feet in diameter, is part of a machine which will be used to interchange current at different frequencies between the generators of the East River Station and the Hell Gate Station These stations are miles apart, but the voltage and cycles are different



UPPER HALF OF TURBINE EXHAUST HOOD

The huge iron casting shown above is part of the 60,000 kilowatt turbines It is the largest casting ever made at the General Electric Plant at Schenectady, New York

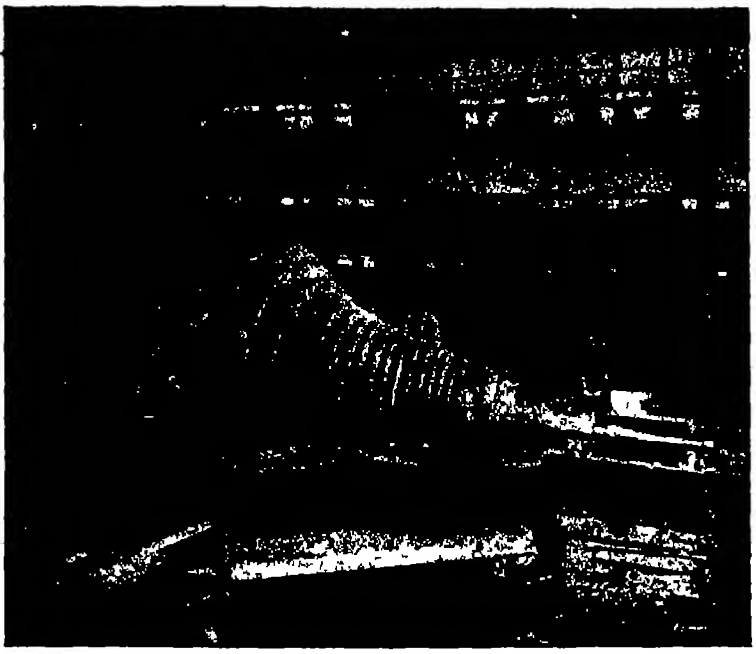


THE ASSEMBLED EXHAUST HOOD

This photograph shows the assembled turbine exhaust hood The condenser is constructed directly below so that exhaust steam passes directly to it

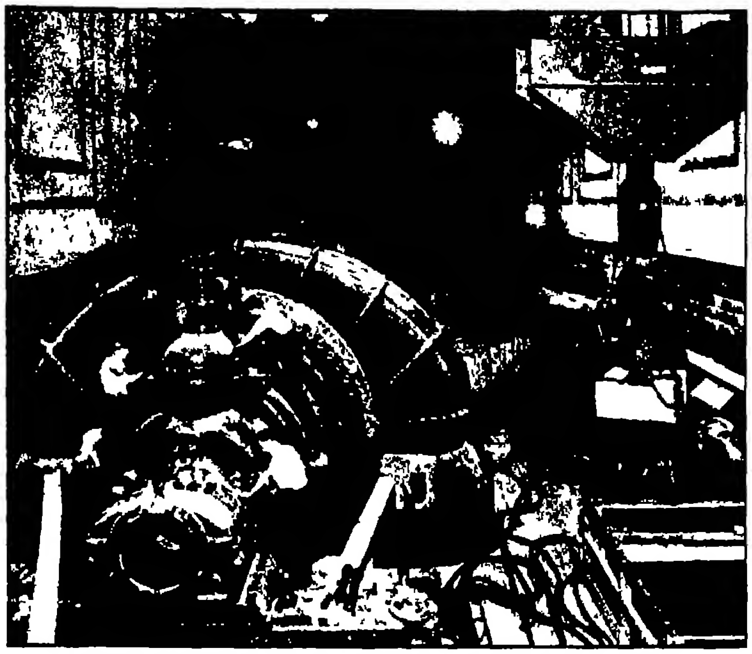
A Power Plant Greater Than Niagara or Muscle Shoals

Sixteen million persons will live in the New York metropolitan area by 1950, according to the estimate of experts. At present, with a population of about 6,000,000 or approximately five percent of the total population of the country, New York City requires close to 10 percent of all the electrical energy generated in the United States. It is not surprising then that the New York Edison Company is now building in Manhattan, the world's largest electric generating station. The station is located at the foot of Fourteenth Street where the river close by will furnish the tremendous quantities of water required by the station for steam condensing purposes The water will flow from the river to the condensers through six-foot, cast-iron pipes buried in the concrete foundations and its volume, more than 800,000 gallons each minute, will be greater than the amount used by New York City for all other purposes combined. It is expected that the station when completed, will have a capacity of approximately one million horsepower This is sufficient to light more than three million six-room homes. The force of the turbines which will develop it is greater than



THE WHEEL WHICH WILL DRIVE THE GENERATOR

This rotor contains 20 sets of blades. They vary in length from four inches on the smallest wheel where the high-pressure steam will enter to 40 inches on the largest wheel. The outer rim of the largest wheel will travel at 12 miles per minute



PHOTOGRAPHING MOST POWERFUL MACHINE ON EARTH

To make it possible to photograph from every angle the most powerful single-unit machine on earth, one of the 60,000-kilowatt turbines at the East River Station, it became necessary to use a 200-ton crane to lift the 150 pound photographer

A CORK FLOOR IN A COAL MILL

To prevent vibration from the coal crushers, which will prepare the coal for the station's boilers, from being transmitted to the building in which they are contained, the concrete foundations of these crushers will be lined with cork. Above is one of the cork layers

ASSEMBLING THE TURBINE FOR TEST

The photograph above shows one of the turbines being assembled at the plant of the General Electric Company in Schenectady. This is the largest single-unit turbine ever built and is capable of power greater than that of 80,000 horses pulling together

that which could be exerted by 1,000,000 horses pulling together. The equipment of this station, parts of which are illustrated in the accompanying photographs, represents the most advanced practices in central station design, yet it is at the same time sufficiently conservative to insure the reliability necessary for the absolute continuity of service which the New York Edison Company has maintained since its organization by Thomas A. Edison in 1882. In the first unit of the station which is now approaching completion, there are two 60,000-kilowatt turbine generators. These turbine generators are the largest single-unit machines which have ever been built. One of them would have been sufficient to supply all the electrical needs of the city twenty years ago. They will generate current at 11,400 volts and 25 cycles. This will be sent to the company's numerous sub-stations throughout the city where it will be converted to 120-volt direct current. Five huge boilers will be used to supply the great quantity of steam for each turbine. One of the unique features of these boilers is that all four walls are lined with steel tubes which carry the water which is to be changed to steam. In ordinary boilers the water is heated only in the rows of tubes at the top of the furnaces. In this boiler by the addition of the water tube walls the heat which ordinarily would be wasted in the brick walls of the boiler, is made use of. The 4,000 tons of coal which will be burned in the boilers of the completed station every day, will be brought to the millhouse by barges where it will be shot into the boilers through nozzles where it will burn in flames 40 feet long, as though it were oil instead of coal. The heat of the waste gases coming out of the huge boilers will not be entirely lost for it will be used to preheat the air which is needed for the combustion of coal under the immense boilers.

"THE SENTENCE OF DEATH," BY THE ENGLISH ARTIST, HON. JOHN COLLIER, TELLS ITS OWN SAD STORY

How Death Deals Its Cards

Death in a Thousand Shapes Is Knocking Eternally at Everyman's Door

By Albert A Hopkins

IF one were to take down one of the catalogue drawers, "De" to, say, "Dg," in a large public library, he would be astonished at the number of entries under "Death" A vast literature has grown up around this subject which is treated from every angle The historian, the philosopher, the artist, and poet, the physician and the theologian have all added their quota to the sum of our exact knowledge, or to more abstract speculation on one of the great mysteries of human existence Great scientists have labored to clarify the conflicting opinions and far-flung theories Investigations along psychic lines have not been convincing enough for us to follow the remarkable tales of the French astronomer, Flammarion, in his volumes on death Death seems to be the finality as far as this world is concerned

We might well ask, "What is death?" A definition is difficult, but the following might answer Death may be regarded as the departure of the principle of life from the body, which brings to an end man's physical relations with other men who are still on earth and with the world of sense as a whole In this sentence, nothing is necessarily implied as to the relation of the dead with one another and with God in a further state of existence, nor indeed of the continuance or disruption of spiritual relations with the living

Death is as necessary as birth for the continuance and progress of the human race and life cannot even be imagined without death. A man's ideas on death depend largely on the particular conditions of his own life and his surroundings, while his ideas and ideals of life may be considerably modified by his views and hopes regarding the nature of death and the nature of the human soul La Rochefoucauld—a wise old philosopher—has said that man could no more look steadily at death than at the sun A life of active duty is the best preparation for the end, and so large a part of the evil of death lies in its anticipation that an attempt to deprive it of its terrors by constant meditation, almost necessarily defeats its object and annihilates the ambition and enthusiasm that are essential to human progress.

We could fill pages with beautiful legends, and curious happenings, but it will prove more valuable to confine ourselves to facts as they occur in the publications of the Bureau of the Census so admirably compiled by Dr W H Davis in the annual portly volume called "Mortality" Our graphical comparisons give the salient figures First we would like to know how the United States compares with other countries Examine the "graphs" of general death rates where we find that we are about as long lived as the inhabitants of England and Sweden, but we fall far below the low death rates of Australia and New Zealand If you want to live long, do not sojourn permanently in Chile or Spain France, Germany and Italy also are not safe abiding places for potential Methuselahs

To Live Long, Live Slowly

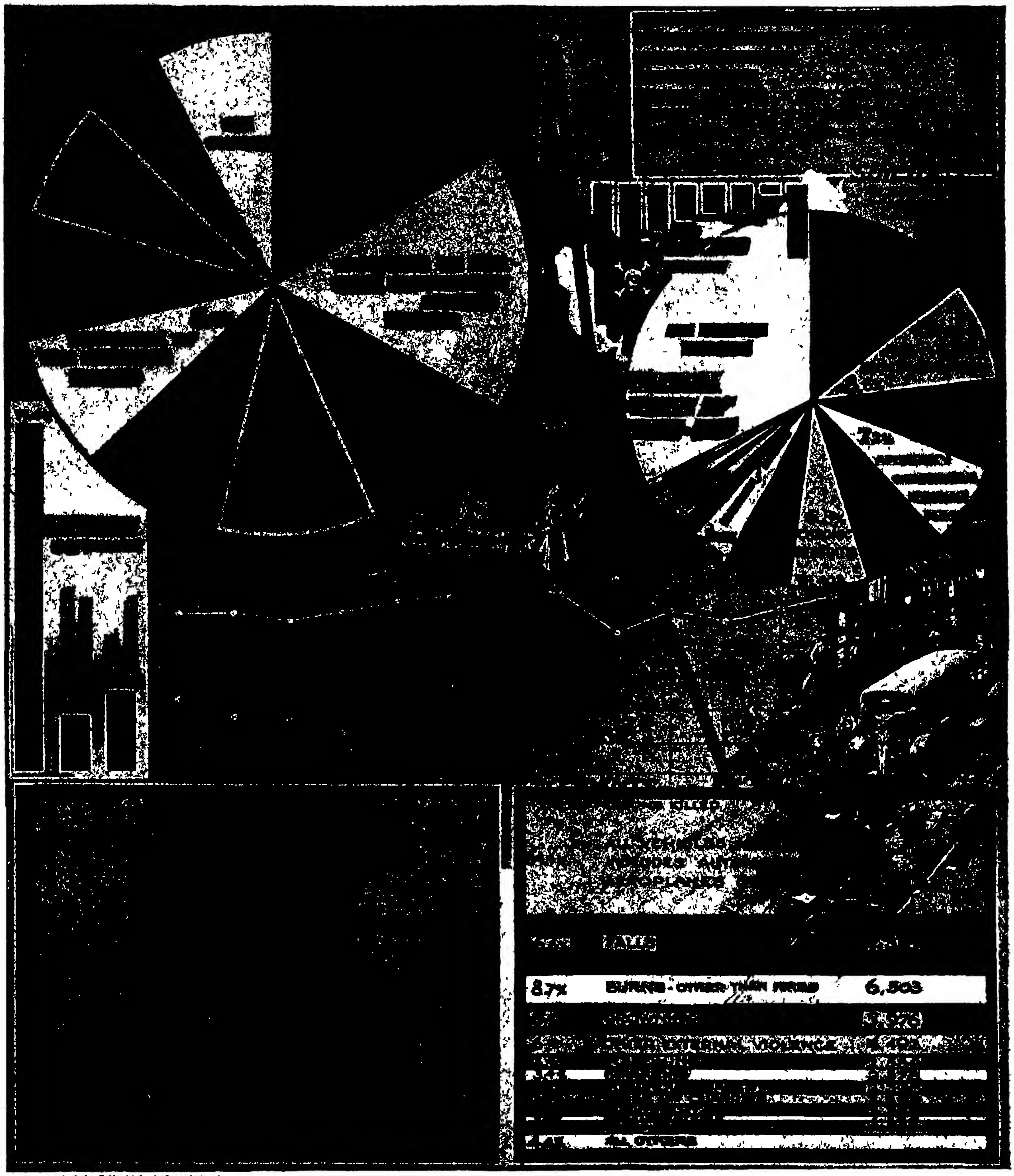
The "pie chart" showing general mortality indicates the great classifications of groups of diseases attacking the bodily system while the other circle gives specific diseases or causes of death. Modern medicine and modern sanitation has profoundly modified some of these figures, but there is still a chance for radical improvements which must largely come from attention to personal hygiene. We drive too hard in this country as our graph indicates.

Accidents totalled 74,131 victims in 1923 Here let us explain that figures of vital statistics are so slow in coming through, and require so much checking that they can never be strictly up-to-date. Inaccurate or hastily prepared figures would be most misleading Of course, we know what "all vehicles" really means "Landslides" are technically classed with automobiles, cars, et cetera The airplane is not a very great risk, as the number of passengers carried is small and the deaths in service flying are not numerous Falls produced 12,378 deaths, many of these fatal accidents were preventable

Suicide and homicide figures have received great attention from statisticians It is interesting to note the methods of self-destruction used by persons who wish to "end it all" One would naturally expect fire arms to top the list, but would hardly think that strangulation (meaning hanging in most cases) would be a close second. Jumping from heights is a particularly vicious method of suicide as in many cases it results in death or injury to the innocent passer-by The government statisticians have even analyzed the poison of the suicide, and carbolic acid which makes such a painful passing out seems to be the most sought for poison.

Homicide cases appear to fall in two classes, firearms, stabbing and slashing So long as we have such poor laws relating to pistols that the gunman can stock up his arsenal at will—while the house-owner can only obtain permits after endless fingerprinting, photographing and red tape plus a substantial fee—we must expect such heavy mortality. It would be interesting to know whether the law ever took toll for many of the 7,878 cases.

The lessons to be derived from a contemplation of figures of mortality are many. Take life easier, avoid straining the heart, watch your step and other peoples' automobiles, do not neglect a cold and cultivate calmness of mind. This is all we can do, but wait—"The old, old, fashion! The fashion that came in with our first garments and will last unchanged until our race has run its course, and the wide firmament is rolled up like a scroll. The old, old fashion—Death."

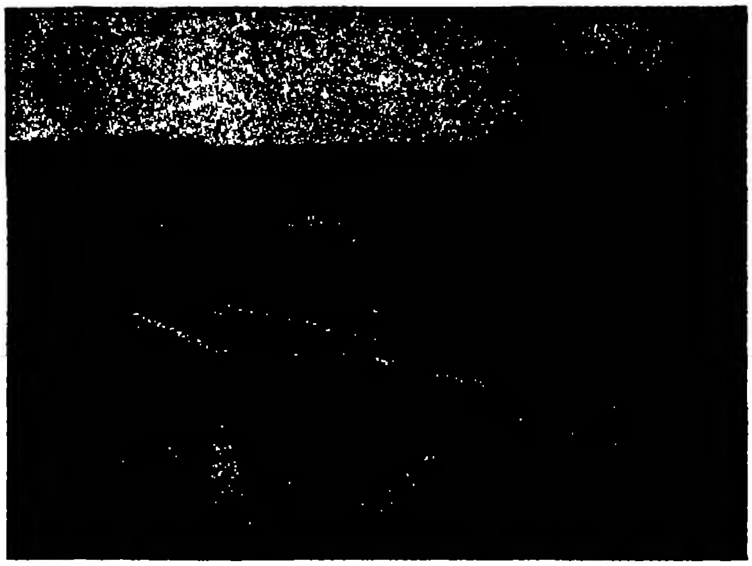


Of What Will You Die? Graphical Comparisons Relating to Mortality

The various causes of death are displayed in graphical form and show what may be the ultimate cause of anyone's death. In the year 1923, the number of deaths in the registration area of Continental United States was 1,193,017. The registration area includes 87.6 percent of the total population of the United States. Some states are not now admitted to the registration area by reason of their unsatisfactory methods of recording death.

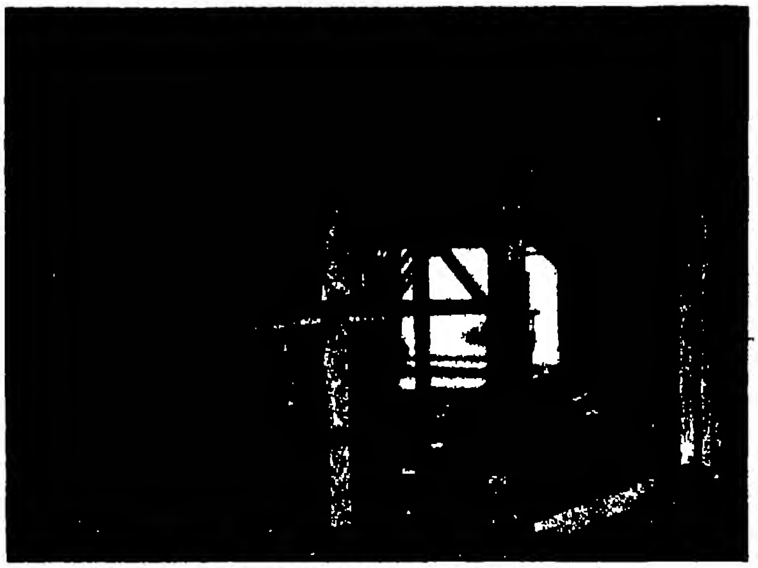
READY TO POUR CONCRETE

Retaining walls of heavy sheet piling kept the spoil banks at the sides from sliding into the open cut On top of the high bank is a concrete mixer ready to pour the floors of the great sewer, while a battery of pumps keeps the water out



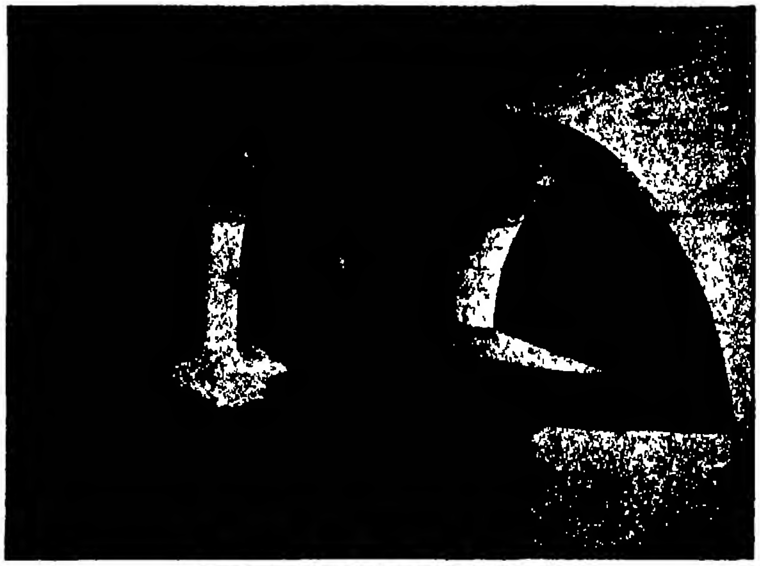
POURING THE CONCRETE ROOF

The floor and walls have been completed and now the roof is being poured. Baskets made of steel reinforcing rods will add their strength to it A stream of wet concrete issues from a mixer situated on the bank beside the job Work progresses rapidly



LINING THE CONCRETE SHELL

When the concrete floor, walls and roof had set, the whole was lined with plastic concrete This work was facilitated by the movable steel framework shown in the illustration. This supported the lining until it had set enough to stay in place



FINISHED AND CARRYING WATER!

This picture was taken at a bend in the triple-barreled sewer Each barrel is amply large to serve as a highway The whole job was called a "sewer" but it really amounted to putting a river underground Even as a storm sewer it is unusually large

A Sewer as Large as a Three-track Subway

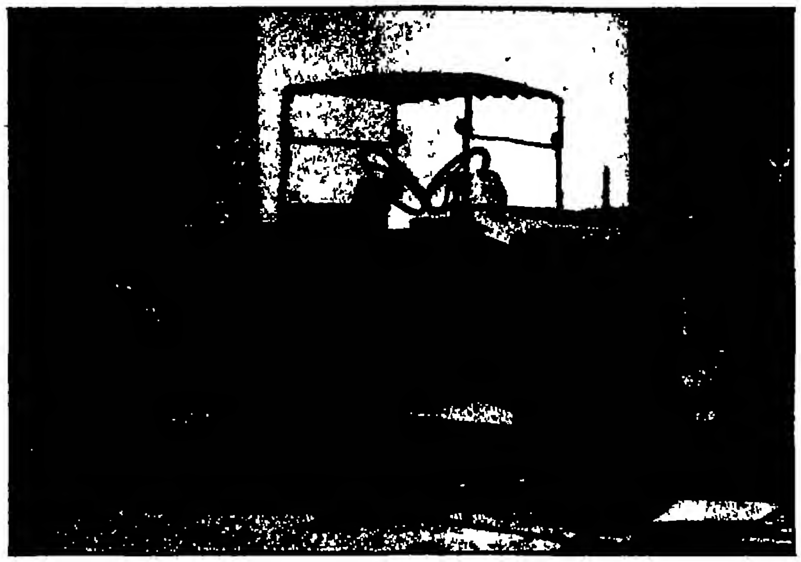
What is said to be the largest sewer in the world, resembling nothing so much as an overgrown three-track subway, yet which is not intended to carry any sewage at all is just being completed in Brooklyn, New York, at a cost of about $3,500,000, according to Frank W. Skinner, C.E. It was built solely to discharge the storm water which falls on an area of 3,500 acres of residential districts It may be forced to carry as much as 67,000,000 gallons per hour Most of the time this great sewer, about three miles long, will be nearly dry The largest portion, near the outlet, will have a width of 47 feet and a height of 13 feet, consisting of three rectangular tunnels, each amply large for a railroad train, separated by partition walls The magnitude of this piece of engineering work is indicated by the vast quantities of material involved, the 10,000 large truck loads of earth and sand which was excavated being sufficient to fill a 100 by 100 foot pit a quarter of a mile deep; the 2,700,000 cubic feet of concrete having a volume as great as that of thirteen twenty family apartment houses, the more than 6,000 tons of steel used to strengthen the concrete weighing as much as that used in the construction of a good sized office building and the 3,000,000 bricks with which the floor of the sewer is paved being enough to lay eight miles of roadway 16 feet wide The most interesting features of this great piece of municipal construction was the unusual methods employed, the rapidity, efficiency and economy with which it has been completed and the fact that it was done in a few months without accident, or much public inconvenience. The work required an army of nearly 1,000 men, and a mechanical equipment of powerful steam, electric and pneumatic machinery of the latest type, which, although it cost more than 200,000 dollars, also saved hundreds of thousands of days' labor. Perhaps the most important elements of this piece of construction were the execution of all the work in an open trench nearly 40 feet in greatest depth, the fact that it was excavated in the center of the street, and that after the completion of the sewer it was refilled with sand and earth and repaved without damage to costly buildings adjacent to it, and with little obstruction to important traffic. This eliminated the slow, dangerous and costly methods involved in the operations of tunneling through treacherous sand, but on the other hand it involved the excavation and rehandling of millions of cubic feet of sand overlying the roof of such a tunnel. Operations were commenced simultaneously at half a dozen approximately equidistant points, at each of which the earth and sand were excavated at the rate of 15,000 to 20,000 cubic feet daily, by steam shovels, scraper buckets and by clamshell buckets. As the excavation proceeded the loose, treacherous sand in the vertical sides of the trench was kept in place by a continuous wall of thick, vertical planks driven by a large battery of powerful hammers operated by compressed air.

Novel Devices for the Shop and the Home

A Department Devoted to Recently Invented Mechanical and Household Appliances

Conducted by Albert A. Hopkins

Simple metal-melting arrangement



This unusual automobile has complete double equipment

Makes its own electricity

Portable Electric Melting Pot

IT has always been troublesome to melt small quantities of metal, such as babbitt, type metal, solder, lead, tin, et cetera, by ordinary methods. Now it is rendered easy by an electric melting pot wherein the current is controlled by a three-heat switch. This device is adapted for ladle and dip work, as well as for pouring.

A Two-way Automobile

"IS this machine coming or going?" one may ask. As a matter of fact, it can go either way since it has double gear controls, and double steering mechanism. One advantage of this machine is that it can be parked on either side of the street, regardless of the direction in which it entered. The car is owned by Mr. W. D Henderson of Memphis, Tenn.

A Spring-driven Electric Lantern

THE electric lantern we illustrate is not a toy but is a sturdy, dependable light for use in camps, boats, factories or the home. It creates its own current by means of a generator driven by a strong spring. When fully wound up, it will give light for three minutes.

Cutting wire screening accurately by machine saves material

Screen Measurer and Cutter

A MACHINE is now in use which assists in making sales of wire screening. A roll is slipped on one of two rods, and the free end of the netting brought through between two flat steel bars. The end of the wire is slipped over small burrs on the second rod, which has a crank handle attached to one end. A movable arm, with two small dials, is placed on the netting, and indicates the amount unrolled. A blunt knife blade is drawn along the slot between the bars, when the proper amount is measured off, and cuts the netting square. The crank is then given a slight reverse turn which frees the burrs and allows the netting to be slipped off the crank rod.

Relief for the Scrubber

WE show in these columns, a rubber mat, of English origin, intended to ease the labors of housemaids or other people who have to do scrubbing. It consists of a rubber pad made in two curved, connected sections to fit both knees. A device of this kind would seem to have other uses; for example, it would aid mosaic tile layers.

An Indoor Bicycle Ride

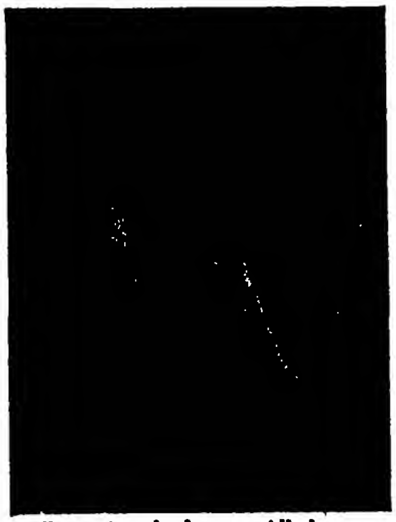
IN the amusement device shown on this page, several bicycles are mounted on a series of concentric rings. These are rotated by a motor and as the bicycles travel in a circle, the passengers can rotate the pedals to their hearts content, thus deriving beneficial exercise and a great deal of fun.

Number of Motor Vehicles in Use

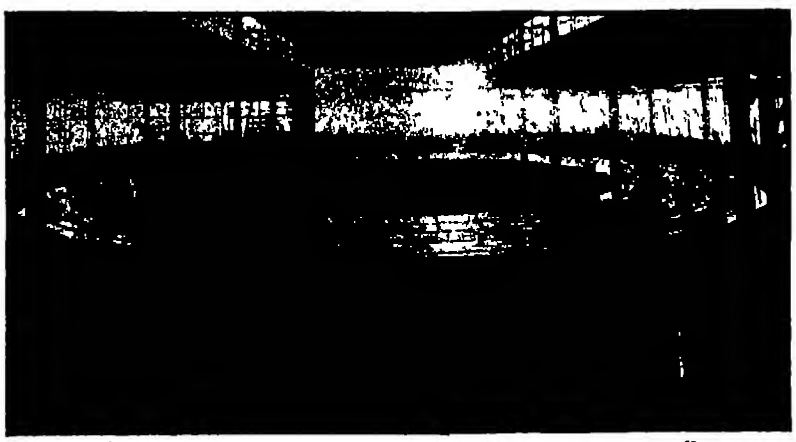
ACCORDING to a report recently issued by the British Ministry of Transport, the number of motor vehicles in Great Britain is now nearly 1,400,000, says *Machinery*. Of these motor vehicles, 533,000 are privately-owned passenger cars, 518,000 are motorcycles, and about 230 000 are trucks, the remainder being taxicabs. There is approximately one motor vehicle in England to every thirty inhabitants, if motorcycles are included. In Germany, there is one automobile for every 272 inhabitants, in France, one for every 69, in Japan, one for every 2,700, in Russia, one for every 9,000 and in China, one for every 40,000.

An Unusual Golf Bag

THE golf bag shown below opens in the center. Each club is held by a metal frame, which supports the bag as well. If the bag is turned upside down, not a club will fall out. The balls are also held by metal clips attached to the frame. The bag locks automatically when closed.



Protecting the housemaid's knees



Novel bicycle ride for the children and for grown-ups as well

An aid to the golfer

Spats for rainy days

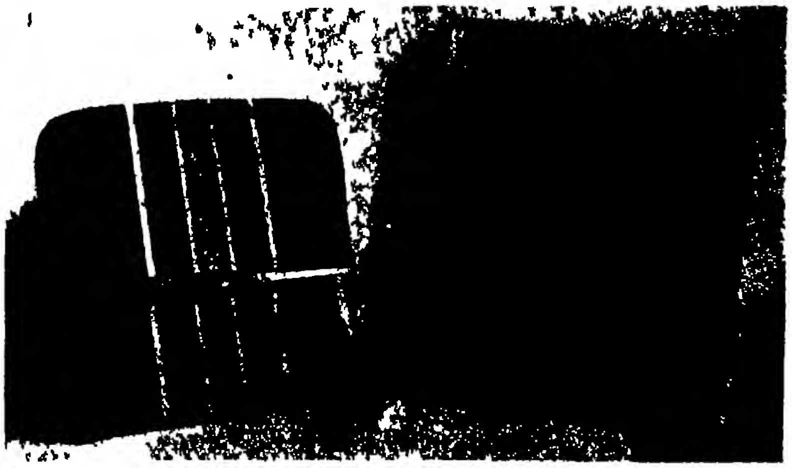
A Convertible Automobile Body

AN automobile body which can be converted from a closed job of standard appearance and rigid top to an open car with a top entirely concealed has been found practicable. The rear end of the body is provided with a cover plate which when it is desired to lower the top is swung back out of the way. The fastening mechanism is then released from the wind shield frame and the top is ready to be swung. This top is hinged to the body and a tensioning lever is provided which includes a cylindrical spring. This is attached to the top and the body proper and assists in raising or lowering the top. It also prevents the top from forcibly striking the bottom of the rear compartment when lowered or the top of the wind shield when raised.

Model showing top concealed

When the top is lowered it is swung back into the rear compartment. The cover plate is then in turn swung back to a closed position and the top is completely concealed from view. With the aid of the tensioning device the raising and lowering can be easily accomplished by one person in a short time. The glass panels are housed in the door when the top is lowered.

Swinging back the hinged top



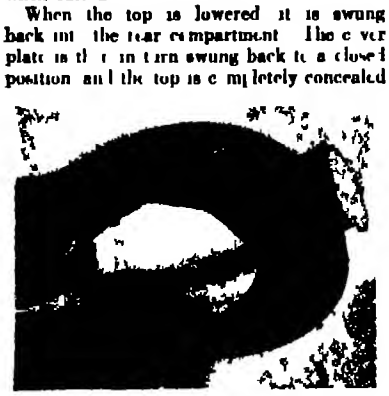
A folding chair which may be carried in a carton

A New Style for "Flappers"

STORES and shops are being besieged now for the last word in flapper vogues. This is in the form of "Sar[illegible]ly Rain Spats," a newly devised gaiter or spat to be worn over the stocking to protect them from mud and rain. This invention fits snugly over the foot and is made of rubber.

Circular Ice Bag

AN improved throat ice bag is made circular in form and has a concealed spring which holds the bag snugly in position. The screw cap is in front out of the way. All ice bags used for sore throats have been made heretofore in some form other than circular which is, however, the logical shape.



An improvement in ice bags

A Comfortable Folding Chair

MOST folding chairs, after one has a tussle with them, yield in time but are as uncomfortable as is possible. In this chair a new folding principle is involved which renders the operation of unfolding easy. The sturdy construction makes the chair stable, thus adding to the comfort. The chair folds in such compass that it can be carried in a small paper carton.

The chair when unfolded

Special cement makes tennis possible in rainy weather

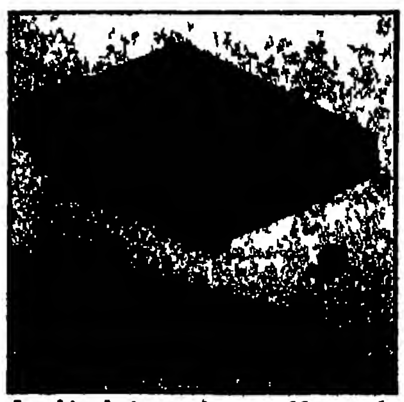
Any-weather Tennis

DESPITE the very bad weather tennis was played in the open in London recently when a demonstration game was given on a new type of hard court. The cement composition soaks up water almost immediately, leaving the court quite dry for playing even while it is raining. The nature of the cement composition was not divulged.

Trolley Cars for Hilly Cities

LISBON, Portugal, like Rome is built on hills; there may be seven or even more—we cannot say. The trolley cars used in Lisbon are built like the mountain railway cars in Switzerland so that the passengers' seats have some claim to the horizontal. This is accomplished by having one pair of trucks directly under the car while the other is placed at some distance from the floor frame. Thus the car really rests on a wedge. To all appearances the trolley is trackless. It is probable that similar cars could be used in San Francisco where the hills are numerous.

A car built like the cars of mountain railways



In this device a demountable match head is held by the prongs and lights on the box. The match burns a long time, even in the wind


Modern seven league boots

Power Roller Skates

AN automotive engineer of Munich, Germany, has designed motor skates which are very ingenious. A motor is applied to each foot and there is even a little fly wheel, fuel tank, gage, et cetera. It is said that considerable speed may be attained with these power roller skates.

An Open-air Crib

ALMOST anybody can build this open air crib. It is, of course, very essential to have the floor supported as shown so there will be no danger of the baby falling. Wire netting should be provided all around, including the top, so there will be no chance for the baby to fall out. A wire door could be constructed to give access to the crib, or the window itself could be shut down so that the child would not fall into the room.


Giving the apartment-house baby light and air without danger

A Universal Clothes Rack

WITH small rooms, every inch of space counts, so that the rack shown is most convenient. Facilities are provided for hanging suits, underclothing and ties, and devices have even been provided for taking care of shoes. We do not know what idea the maker had in mind when painting it white, but it is a good one since the rack can be distinguished in poor light.


Arranging clothing neatly

A Novel Bank Check

A NUMBER of banks are using the form of check shown in the illustration which does not differ materially from that which has been in use for a long time on money orders. The idea is, of course, to protect the customer against the raising of a check. On the margin, there are printed amounts on the left end of the check so that the amount of the check may be cut into the margin and any attempt to alter the face value will be disclosed immediately.


An effective and simple way of protecting a check

A Latitudinally Bound Tire

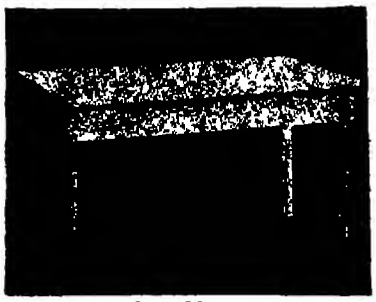
THE present automobile tire is bound by cords both longitudinally and latitudinally in order to give sufficient body to the tire. The newly patented tire is bound latitudinally—from rim edge to rim edge—but is not bound longitudinally. That is, while cords run crossways in the tire, no cords run in the circumference of the tire. As a result, the tire may expand and contract like a rubber band in the direction the wheel travels, but cannot change its other dimension. This condition gives a remarkable resilience to the new tire. Perhaps the most astonishing feature of the invention lies in the manner in which the new tire is fastened to the metal rim. All lugs, all bolts, the collapsible rim and the shoulder are done away with. At the edges of the new rim, the metal thickens to give a perfectly smooth top surface an inch wide with a twelve and one-half degree taper whose highest point is on the outer side. Correspondingly the tire has its edges formed in a nonelastic bead with an opposite taper to that on the rim. The inner tube is put on the metal rim of the wheel unit, the new tire slipped into place with no more than hand assistance, and the inner tube is inflated.

The longitudinal elasticity of the new tire permits the air to absorb a large percentage of the stresses which wear the common tire. When the new tire encounters a stone or other obstacle, thanks to its elasticity it tends to fold about the obstacle and absorb its shape rather than to pass the shock on to the car or to accept damage to itself. This elasticity absorbs the traction wave, or forward movement of the car and eliminates tire heating.


Holding the tire on the rim by air pressure is feasible

Combination Table and Desk

THE table which we illustrate is intended for the use of children. It may be used as an ordinary table, or part of it can be raised so as to form a desk.


When the table is a table


When the table is a desk

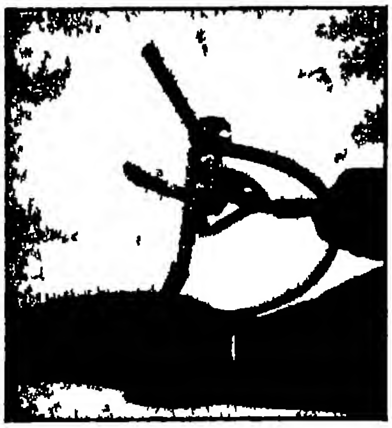
A Welding Wrinkle

A PRINCIPLE to be observed in all oxy-acetylene welding operations is never to direct the torch flame upon the welding rod to melt it, says *Power*. The flame should be directed against the joint so as to form a puddle of molten metal. The welding rod should be melted by the heat of the puddle and the radiation from the torch flame. By always forming a puddle in the V and adding to it from the welding rod, using the heat of the puddle to melt the rod, the welding operator is reasonably sure of obtaining penetration and cohesion.

Left: Canvas strips and letters are pasted on the pavement *Center:* How the letters are applied *Right:* Strips are great aids to traffic regulation

Pasted Letters for Traffic Control

WHEN we visited the armory at the recent Safety Congress at Albany we were struck with the simplicity and practicability of canvas letters which were pasted on the floor and we are now able to show our readers some excellent examples of how these letters work out in practice. Markings of various kinds are provided as well as letters. Arrows, curves for turns, et cetera enable almost any traffic problem to be solved. The letters come in pairs—back to back. The two letters or strips are separated



Breaking the cable's armor

at the top, then with a quick jerk they are pulled apart and are ready to be applied to the pavement—the surface of which must be perfectly dry and swept clean. The temperature when applying the strips or letters should be about 55 to 60 degrees Fahrenheit. A chalk line gives perfect alignment. The letters or strips are lined up on the chalk line—the letters being arranged to form desired words. A one-quarter inch

Cooled, germ free receptacles

lap is provided. Then the edges are pressed down with the foot and the letters are ready to withstand the heaviest traffic which will not wear them out except after a period of three to five months or longer. The pavement markings look much more finished than if the letters were done by hand and the cost is less.

Now Run by Electricity

NEARLY all the milling plants at the old tin mines of Cornwall, England are now run by electricity although steam is generally used for pumps and hoisting.

Exit the Armored Cable Hatchet

THE hatchet is a time-honored tool for cutting armored cable. It bruises the armor, leaves burrs on the wire and mashes the insulation. A manufacturer of armored cable realizing these difficulties has brought out a tool that makes cutting armored cable easy for the contractor. The tool is first gripped on the cable, then the handles are opened as far as they will go. This serves to break the armor. The handles are then closed and the armor and the wire is cut. The cable slips out of the tool and then it is possible to slide off the armor.

Keeping Liquids Germ-Free

THE inventor of this device is shown here with one of the removable ice chambers she makes for pitchers, punch bowls et cetera to eliminate possibility of getting impurities into the liquids from melting ice. The ice is confined in a detachable chamber which fits into the base of the bowl or pitcher.

Protection from Snow and Cold

THE device which we illustrate provides ample protection against snow, sleet, rain and extreme cold. These boots are both ankle length and knee length and are for wearing when using skis. They form a part of the ski itself. No snow can soak through so that the shoes or moccasins are kept dry. The boot—as we term it—is made of fabrikoid. A foot board is provided to which the foot harness is attached. This new article will be of great service in the northern part of the United States and in Canada.

Foot comfort and warmth for the winter sportsman

Eliminates Sprinkling

A NEW type of electric iron eliminates the need of sprinkling as steam is provided from a water reservoir in the handle. It is worked like any hand iron. A simple conduit leads from the reservoir to the heated bottom plate. The steam does the dampening, prevents scorching, saves

New tool cutting the wires

time. The device spreads moisture evenly through tiny holes in the bottom plate. This forms a mist-like film of moisture that is evenly distributed between the ironing surface and the garment, dampening and freshening the goods as the iron is used. Of course the added steaming feature does not in any way interfere with the iron for ordinary work.

This iron sprinkles clothes

The Scientific American Digest

A Review of the Newest Developments in Science, Industry and Engineering

Conducted by Albert G. Ingalls

Nitro-Glycerine Made Safer

Oil-well shooting, one of the most hazardous of occupations, has been relieved of some of its danger through the invention of a new non-metallic container for the nitro-glycerine used in the underground blasts.

In most oil fields of the world an explosion at the bottom of wells which have just been drilled into the petroleum bearing sand stone stimulates the flow by shattering the rock and opening channels leading to the well opening. Subsequent blasts are placed in order to remove the paraffin which tends to clog the minute passages between the sand grains and to extend further the existing channels.

Nitro-glycerine is universally used as the explosive. It is lowered into the wells in shells from three to six inches in diameter and from 40 inches to 11 feet or more in length.

From the first days of the oil industry these shells have been made of tin. But the undesirable features of that material led to a search for a superior material which extended over the last 20 years.

The greatest danger due to the use of tin tubes is in the generation of frictional heat while the shells of explosive are being lowered through the iron casing of the wells. It is not uncommon for premature blasts to occur from this cause, endangering lives of workmen and damaging or destroying wells which have cost many thousands of dollars to drill.

A new type of shell which has recently been invented is made from compressed paper impregnated with molten sulfur. Sulfur melts at a temperature below the firing point of nitro-glycerine. Therefore, the development of frictional heat softens the exterior of the sulfur shell and prevents the transmission of the high temperature to the explosive inside.

The new shell also possesses the asset of being highly frangible. When the explosion takes place it is rendered into bits. Being combustible, most of these fragments are consumed by the heat of the blast. Those that survive are so small that they do not aid in the tendency of wells to stop up or "bridge" with rock fragments blown up into the casing by the shot.

These bridges minimize or even nullify the effect of the explosion, as it is necessary for a well to clean itself immediately after the shot, through the action of its own flow of oil. Tin has a tendency to shred and these shreds often contribute directly to the formation of bridges.

The impregnated paper shell is made with end castings formed from a newly patented carbon-sulfur compound, the castings being firmly cemented in place. The new shells have a greater structural strength than tin and, it is claimed, are also more elastic, thus reducing the chances of premature explosions due to shocks received while they are being handled just before lowering them into wells.

The old-fashioned "hell-wagon" that traversed the oil regions by night has given way to a motor truck, while the metal shell which contained the nitro-glycerine may give way to a paper shell such as shown above

* * *

Largest Metal Crystal Ever Made

The crystal of copper shown in the accompanying illustration, somewhat resembling a projectile in appearance, is 17 inches long, 2⅛ inches in diameter, and weighs slightly more than 12 pounds.

It was withdrawn from the electric furnace at a rate of one-quarter inch an hour. This permitted the atoms of copper to arrange themselves regularly throughout the entire piece of metal.

One of the outstanding properties of such single crystal copper is that it will conduct electricity 13 percent more efficiently than will ordinary copper, which is composed of tiny crystals in chaotic arrangement. Another unusual property of single crystals is that a rod of the metal can be bent easily. Having been bent, however, the single crystal is broken up into small crystals, and then it is as difficult to bend as is ordinary copper.

Numerous experiments and investigations are being conducted to determine the properties of single crystal metals.

In one of its remarkably compact and informative "Research Narratives" entitled, 'Super Conducting Copper—a Tantalizing Achievement Which May Lead to Industrial Economies," the Engineering Foundation (New York) publishes the following statement contributed by L. A. Hawkins of the research laboratory of the General Electric Company at Schenectady, New York.

'Professor A. E. Kennelly, in his Research Narrative, 'A Retrospect in Research,' tells how Lord Kelvin in 1857 found that copper wire used in cable manufacture differed much in conductivity, and urged that transatlantic cables be made of high-conductivity copper—chemically pure metal, capable of transmitting current with much less loss than occurred in the usual, more or less impure, copper. This was one of the early applications of research to finding better electrical conductors.

"From that day to this, pure copper has been used almost exclusively for electrical transmission. The only known material with higher conductivity than pure copper is silver, a metal too costly for use in line wires.

'But in spite of this settled practice, interesting questions remained. Why is silver more conductive than copper? Why is copper, next to silver, more conductive than all other metals? Is its conductivity absolutely a fixed thing, or is it susceptible of increase by special treatment?

"A small increase in the conductivity of commercial copper would have great value. An increase of even ten percent would release for other fields an enormous tonnage of copper now used for transmitting power. The economic radius of all existing transmission systems would be increased ten percent, increasing by 21 percent the area served, or the underground cable subways of cities, so many of which are taxed to capacity with their loads of today, could without enlargement carry additional loads of ten percent.

"So, when Dr. W. P. Davey, of the research laboratory of the General Electric Company, found by calculations, based on the arrangement of the copper atoms which the X rays revealed, that copper composed of a single crystal should have a conductivity 14 percent greater than ordinary copper, greater than that of silver, possibilities of great scientific interest were disclosed. In order to check his calculations, Dr. Davey proceeded to devise apparatus for producing large single crystals of copper.

"The single crystals were made by very gradually heating and cooling pure copper in an electric furnace. When molten metal is quickly cooled, very small crystals are formed; if the melt is cooled slowly, the crystals are larger. Dr. Davey cooled the melt so slowly that only one crystal was formed, and that included all of the metal. By this method he was able to produce single crystals three-fourths of an inch in diameter and six inches long, and one that is 14 inches long.

"The conductivity of these crystals was then measured, and, although the quantities involved were only 36/100,000ths of a volt and 18/1,000,000ths of an ohm, measurements by different methods were made which checked within one-quarter of one percent. The measured conductivity was 113 percent that of pure polycrystalline copper, within one percent of the calculated value.

"In a crystal, the atoms—the unit particles of the substance—are built up in regular fashion. The crystals of copper, for example, are made up of very tiny cubes, with atoms of copper at the corners and centers of the faces of each unit. The large crystals grow in such a direction that the atoms are arranged in columns along the length of the crystal. It is this regular arrangement of the atoms, which, it is believed, gives to the single crystals their superior conductivity when compared with ordinary (polycrystalline) copper, in which the crystals are small and the arrangement of these small crystals quite chaotic.

"There is reason to believe that the conductivity of copper crystals along another axis from that measured may be even 60 percent greater than the value for pure copper, but the growth of single crystals along this other axis has not yet been brought under control.

"Unfortunately, there is no immediate prospect of utilizing commercially this newly discovered high conductivity, for the single crystals are very delicate and difficult to manufacture.

"One of the first facts discovered about single-crystal copper was that the specimens could be bent double with one finger, but that strength was required to straighten them afterwards. A crystal of the size of a lead pencil, if given a jerking motion, bends like a stick of soft wax. Having been once bent, however, it acquires the properties of ordinary copper, for the bending has transformed the large crystal into a mass of smaller ones."

Courtesy of General Electric Company

Dr. T. A. Wilson, of the research laboratory of the General Electric Company, holding the world's largest single crystal of copper

* * *

"Coffin Nails?"

Now that Prof. J. Rosslyn Earp, of Antioch College, has just investigated tobacco smoking among students and stated that he finds that lowered mental efficiency is a consequence of smoking, and since his findings have been published in most of the newspapers and many of the magazines of the land, some investigations made by Sir Humphrey Rolleston of the University of Cambridge, England, and published in the well known medical journal, *The Lancet* (London) should be of increased interest. They are not inserted with any prejudice concerning tobacco, since the majority of the editors of the Scientific American, including the present writer, smoke.

Tobaccos vary considerably in their nicotine content, says Sir Humphrey, pipe mix-

(Continued on page 372)

DANDRUFF?

Now you can control it!

YOU need worry no more about dandruff, that unsightly nuisance, so embarrassing to both women and men.

As you probably know, dandruff is a germ disease that no intelligent, fastidious person can afford to neglect. Because so often it is a warning of more serious scalp trouble—possibly baldness.

There is one ideal treatment to control dandruff conditions—the systematic use of Listerine, the safe antiseptic. It really works wonders this way.

The use of Listerine for dandruff is not complicated. You simply douse it on your scalp, full strength, and massage thoroughly. You'll enjoy the cleansing refreshing effect And you will be amazed to see how this treatment, followed systematically, does the trick

Moreover, Listerine will not discolor the hair nor will it stain fabrics. And it is not greasy.

Try Listerine for dandruff. You'll be delighted with the results.

Lambert Pharmacal Co, St Louis, U S A

Well—it worked! For quite a while we challenged people to try Listerine Tooth Paste. Sales now show that when they try it they stick to it! LARGE TUBE—25 CENTS

LISTERINE

—and dandruff simply do not get along together

tures having the highest. The nicotine content of the tobacco and its smoke do not, however, vary directly. *It is the way in which the tobacco is smoked and the degree of combustion (formation of carbon monoxide) that are the important factors.* Thus, Virginia cigarette tobacco contains 1.4 per cent of nicotine, which is nearly twice as much nicotine as Manila cigar tobacco. Yet cigar smoke contains more than double the amount of nicotine found in cigarette smoke.

The smoke of Virginia cigarette tobacco contains only .06 percent nicotine when smoked in a cigarette. But when burnt in a pipe, 37 to 53 percent of the content of the smoke is nicotine, or several hundred times as much.

The degree of combustion—of which more later—is most complete in cigarettes, least in a pipe and midway in the case of cigars. In pipes as much as 70 or 80 percent of the nicotine in the tobacco may pass into the smoke, but a good deal depends on the length of the stem of the pipe. For example a church warden pipe with long stem allows the nicotine to cool and condense in the stem to such an extent that very little passes into the smoke.

Nicotine collects in the moist area of a cigar behind the burning tip and, if it does not undergo complete combustion may be carried into the mouth by the hot smoke. Therefore a half burned cigar should not be relighted. Thus it has been stated that a smoker who relights a pipe or cigar absorbs more poison than he would from ten ordinary smokes.

According to Dixon the smoke of one cigar contains as much nicotine as that of 12 to 18 cigarettes. The general opinion, says Sir Humphrey, is that cigarette smoking is the form likely to give the worst results, then cigars and lastly pipes. He reverses this order saying the evil reputation of cigarettes has been ascribed to their patronage by unstable neurotics who are unable to stand cigars and pipes. Thus these critics have the cart before the horse.

However two other reasons are given for the more evil influence of cigarette smoking, many more cigarettes than pipes are smoked and the smoke is inhaled. Thus nicotine and carbon monoxide are more certainly introduced into the body and furfurol or furfuraldehyde an artificial oil of ants exerts its irritating effect producing smoker's throat and smoker's cough.

According to Armstrong cigarette smoke contains up to one percent of nicotine *but more when smoking is rapid than slow.* A Havana cigar when smoked quickly gives as much as eight percent of carbon monoxide, or as much as there is in London city gas! *The effects of cigarette smoking appear to be chiefly due to carbon monoxide* (this is the poisonous gas that is discharged in the exhaust of a motor car due to incomplete combustion often killing owners who run cars in enclosed garages), also pyridine (an alkaline solvent), furfurol and ammonia.

But cigar smoke is powerful mainly on account of its nicotine.

Oddly enough the older methods of using tobacco, namely, chewing and snuffing, are said to be attended by little absorption of nicotine.

Everyone has noted the satisfying effects of smoking when hungry. It is explained thus: the motility or contractability of the stomach soon becomes paralyzed and remains so for an hour or so. And it is on this motility that the feeling of hunger depends.

* * *

Helping the Surgeon to See Red

WHEN we think of the hospital operating room we picture it with spotless white tile floor and wainscot, white upper wall and ceiling, and white enameled furnishings. White has always typified cleanliness and it was natural that the attempt to eliminate dirt and bacterial contamination in the operating room should have led to the choice of white. There is one other reason for choosing white. The maximum reflection of light necessary for surgical work is best obtained from white walls and ceiling.

Interior of an operating room at St. Luke's Hospital in San Francisco. The finish is in green instead of white as is customary in operating rooms

But despite these advantages of white, which experience has proved are largely theoretical there are some very evident disadvantages. These have been overcome in some hospitals according to Dr. J. Marion Read of San Francisco by utilizing colors rather than white as a finish for the operating room. The colors used are dull French gray, dull ivory, olive green and dark spinach green.

One of the first hospitals in this country to depart from the customary white operating room was Saint Luke's Hospital in San Francisco. When the new hospital was constructed the floor and wainscot of one of its operating rooms were finished in green tile. This was the idea of the chief surgeon, who called attention to the fact that the particular shade of green selected was dark or "spinach" green. This shade of green is the complementary color to hemoglobin or "blood" red.

In this fact is to be found the reason for departing from the conventional white as an environment for the surgeon. Its dazzling brightness is blinding to the surgeon's eyes when he raises them from the operating field where the predominating color is red. Complementary colors afford the greatest eye relief and in this case both theoretically and practically, dark green proves the most efficient in combating the color fatigue to which the surgeon is subjected. In addition to lessening color fatigue, complementary colors also intensify their opposites. Thus the operating field stands out more clearly in the surgeon's vision after gazing for a moment at green. To bring this relief and contrast closer to the surgeon's eyes, the wound is often surrounded by blue denim, or black towels instead of the usual white ones.

There are some very curious and interest-

ing facts regarding these two complementary shades. For example, green has long been recognized as restful to the eyes. This is illustrated by the use of green for eye shades, automobile sun-visors and many non-ornamental lamp-shades. Green also suggests coolness, perhaps because it is the predominating color in trees and grass. This thought brings to mind one of the most astonishing relationships in the world of nature, the similarity between the green pigment of plants and the red coloring matter in the blood of animals.

Chlorophyll is the chemical substance which gives all green plants their color, while hematin is responsible for the red color of blood. These are both very complex substances, yet chemical analysis reveals that they are almost identical in composition The chief and practically the only difference between them is that hematin has one atom of iron in the molecule, while chlorophyll has none. It is probably this atom of iron which is responsible for the difference in color between "chlorophyll green" and hemoglobin or "blood red."

These green and red chemical compounds, besides being essential to the respiration of plants and animals, respectively, are also important in the physiology of vision That is why the esthetic white operating room gives way to the more practical green one in which natural conditions are simulated and vision is aided.

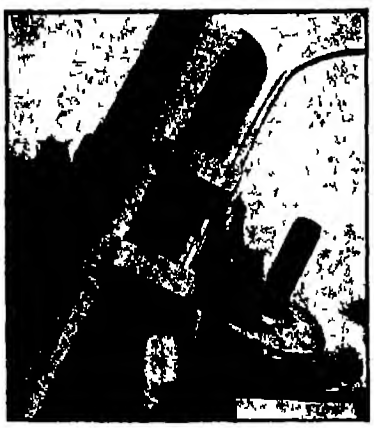
* * *

Real Estate Broker Makes Interesting Telescope

To the editors, it is an everlasting source of marvel that so many expert mechanics exist among those whose vocations have no connection with skilled manual work For example, the telescope made by H L. Rogers, 10 Adelaide Street, Toronto, Ontario, is a credit to its maker At our request, Mr Rogers submitted the following letter describing his telescope

"I enclose two snapshots of a six inch reflecting telescope, the construction of which was inspired and directed by your articles by Russell W Porter, and by your wonderful little book on the subject

"As I have a rather poor horizon near my home I decided to construct a telescope which would be more or less portable, and so I built the equatorial mounting of one-quarter inch brass plate throughout, feeling that this would give me a fairly light, and yet strong, instrument Where the plates are joined at right angles, I used a home-made end milling cutter with a 7/32 inch central hole and milled dowels on the edge



Mounting of the Rogers telescope

of the upright plates. These were rivetted through adjoining plates, forming a very strong and neat joint The milling cutter was used to clean out the spaces between the dowels.

"The construction of the mounting follows fairly closely the principle outlined by Mr Porter on page 31, 'Amateur Telescope Making.' The photographs show a slow motion of the equatorial plate. This has proved very satisfactory and rigid.

"The spindle of the slow motion is a three-eighth inch brass rod, threaded with

Mr. Rogers' equatorial telescope, made almost entirely of brass

24 threads to the inch from end to end, with a steel boss threaded and soldered to the middle of the brass rod, engaging three teeth on the steel slow-motion plate The latter is of about one-sixteenth inch cold rolled steel The rod is supported by two one-half inch blocks and is threaded through them. The adjusting wheels are threaded and soldered to the spindle, as shown in the photograph. This turned out to be a suitable slow motion

"I had intended using a slow motion only on the equatorial plate but the type above described proved so satisfactory that I have since added a similar slow motion around the declination axis, which gives a very fine control of the instrument

"Some difficulty was experienced in anchoring the 9/16-inch steel rod for the balancing weight This was done as follows the rod runs through two oak distance-pieces which hold the tube in place A flat area about three inches long was filed on the rod. Engaging this flat is a one-quarter inch steel plate This clamps the rod very securely to the base plate, as it has such a large bearing on it The telescope tube is held by 1¼ inch brass bands looped at their ends to take one-quarter inch brass screws and nuts.

The flange for the eyepiece tube was easily swaged out of a piece of 3/32-inch brass plate finished in the lathe

"The telescope tube is built up of 26-gage, hard rolled brass fastened with small round-head screws and nuts. Solder is also sweated into the joints, making a very strong and light tube

"A collar of the same material as the holding bands was soldered and riveted to each end of the tube At the bottom end of the telescope tube are three projecting one-quarter inch studs with two lock nuts on them to form adjustable stops, against which the three arms of the speculum cell are held by wing nuts. The speculum cell is built up of brass with a heavy spring brass collar sprung to fit the inside of the cell walls. This holds the speculum firmly and rigidly on a bed made of filter paper and a thin sheet of wood [Just firmly is enough. If held too firmly the pressure will distort the optical figure of any mirror—Editor] Later I fastened the collar with small countersunk screws in order to prevent the mirror from rattling loose.

"The diagonal mirror in the telescope tube is held in a tripod built up of sheet brass with a three-eighth inch adjustable hole through the center The mirror itself is mounted on a plate which in turn is held by a three-eighth inch round brass rod which fits in the central hole of the tripod, thus providing an axial and up and down movement in relation to the telescope tube. The second diagonal mirror is clamped between two pieces of brass tube with 45-degree ends which are split and sprung into the inside of the eyepiece tube, giving an adjustable, yet firm mounting for this mirror

"The base plate of the mounting is equipped with adjustable feet The oak stand shown in the photograph has proved very satisfactory and as rigid as one could expect. I intend to fit the stand with plumb and compass, for rough adjustment.

"I have not kept precise track of the expense for materials but I believe I could safely say that the expense would not be more than between 40 to 50 dollars—possibly less.

"All brass parts have a brushed finish, polished and lacquered, and the instrument has quite an attractive appearance.

"The blocks holding the equatorial slow motion each consist of two pieces of brass soldered together to make one-half inch thickness, and the joint is quite invisible.

"The instrument has been in operation only about one week and I have already examined the rings of Saturn and a wonderfully beautiful image of the moon, with perfect definition It is astonishing how many stars make their appearance in the instrument which are not visible to the naked eye, and I am now faced with the necessity of brushing up my astronomy in order to know what I am looking at [Many amateurs, having completed their telescopes, write that they are facing the same necessity We recommend Fath's new "Elements of Astronomy," a lucid, up-to-date book for the beginner—Editor]

"*I found, after wasting a lot of time, that if I had observed all the instructions in 'Amateur Telescope Making' very carefully, even those which seemed altogether unnecessary, I would have saved myself a great deal of time*

"On the whole, however, making the instrument has proved a very interesting recreation, and I am more than pleased with the success of it. I am an amateur at running a lathe and there is absolutely nothing about the mounting or tube that cannot be made by any amateur with average ability"

• • •

Rain and Snow Fertilize Soil

RAIN and snow water the fields and meadows, but not many people know, says Dr Frank T Shutt, Dominion chemist of the Canadian Department of Agriculture, that they also fertilize the soil They wash down out of the air and into the earth enough nitrogenous substances to make a real difference in the farmer's fertilizer bill. In the vicinity of Ottawa, the amount of such fertilizer added free of charge to the soil each year has been measured and found to be equivalent to 44 pounds per acre of

expensive imported Chile saltpeter. There is, after all, a "pot of gold at the rainbow's end," at least for the farmer

"The Canadian experiment," Dr Shutt said, "covered a period of seventeen years and has given valuable information on the part played by rain and snow in maintaining soil fertility Precipitation also plays an important role in purifying the atmosphere, and the Ottawa experiment has approximately measured the extent of this useful work."

Every rain and snowfall for 17 years that yielded enough for experimentation was analyzed, Dr Shutt explained, and the amounts of free ammonia, nitrates, nitrites, and albuminoid ammonia were measured These are the forms in which occur the sort of nitrogen of the air which can be assimilated by plants as food

Although air is normally four fifths nitrogen itself, it is only the small quantities of this substance already in combination with other chemical elements that are of use to plant life. The enormous quantity of nitrogen gas in the air is useless, and plants may starve for nitrogen while immersed in an atmosphere of it

The "combined" forms of nitrogen enter the air in various ways, Dr Shutt said Plant and animal matter contains nitrogen, and ammonia gas forms and goes into the atmosphere when these decompose. Smoke from houses and factories spills its compound nitrogen into the air, and lightning bolts in thunderstorms smash atoms of hydrogen and nitrogen together to form ammonia, just as the difficult electrical "arc process" does in the man made laboratory These substances are sooner or later washed out of the air into the soil.

Most of the combined nitrogen of the air occurs as free ammonia, and this is always much larger after forest or bush fires. There has also been a steady increase in recent years in ammonia in the air, Dr Shutt said, because of the increased use of soft coal

The amount of total nitrogen brought down to the soil out of the sky each year varies greatly, according to Dr Shutt, and it is not always possible to account for the variations. Around Ottawa, the average amount of nitrogen thus added to the soil is from six to seven pounds per acre in a year During one year this amount jumped to more than 11 pounds This was believed to be due to the new factories in the vicinity

Snow is decidedly poorer in nitrogen than rain, it was found It carries only one-half as much free ammonia and also considerably less of the other nitrogen compounds. Snow carries only about half as much useful nitrogen as an equal amount of rain, and as there is more rain than snow during the year, rain contributes nearly six pounds of nitrogen to the soil while snow gives a little more than one pound —*Science Service*

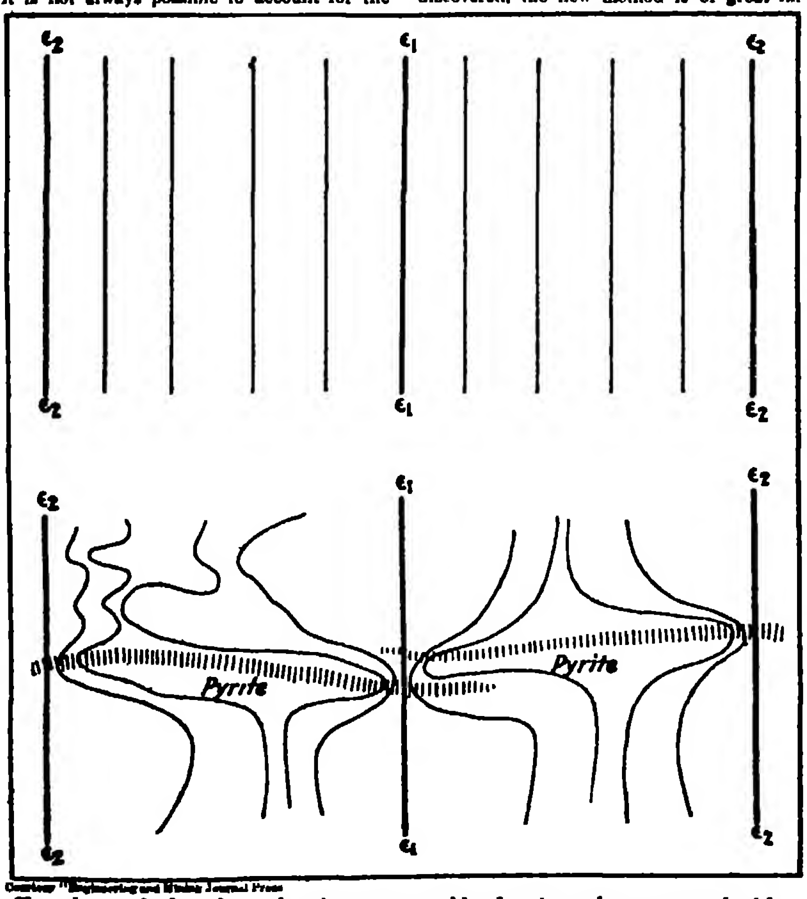
* * *

Electrical Prospecting Method Finds Gold Deposit

A GOLD ore deposit thought to be of gigantic proportions has been discovered at Bolliden, Sweden, in the province of Vester botten, not far from the Arctic Circle, according to Dr Axel Gavelin head of the Swedish Geological Survey Electrical prospecting methods developed by Hans Lundberg and Karl Sundberg, mining engineers, are responsible for the find It comprises 34 ore bodies, all covered by glacial drift, swamps or lakes.

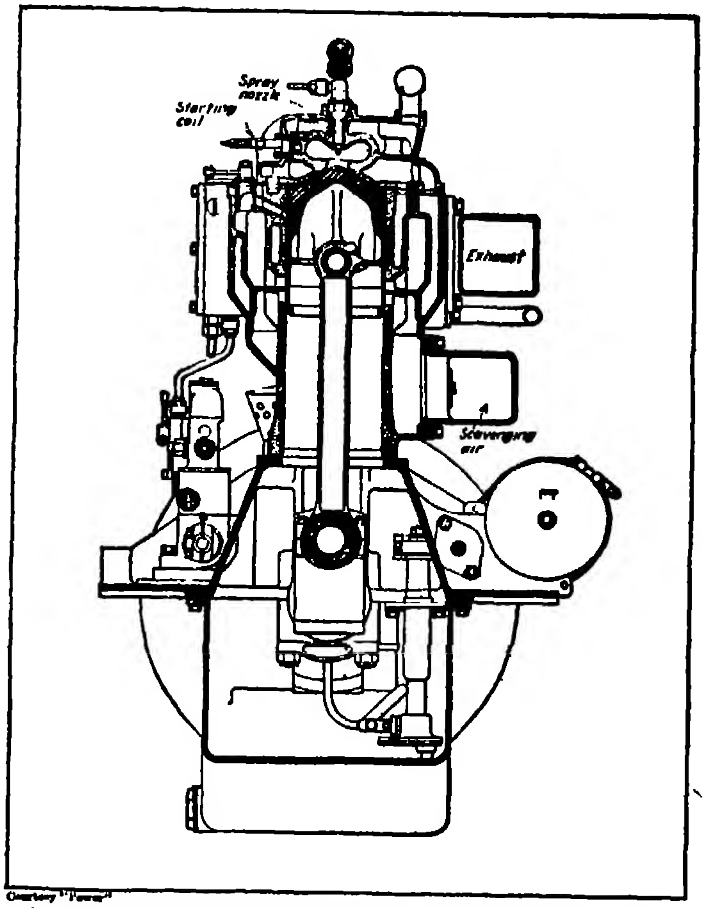
Discussing the find, Dr Gavelin said it was all the more interesting because of the unique methods by which it was discovered. The electrical "divining rod" is no poor relation to the "witching rods" found throughout the world, he said, for the new electrical device is based strictly upon established scientific principles and no element of mysticism enters into its operation. A parallel electrical field is conducted into the earth and equipotential lines in the surface are fixed by the use of extremely sensitive telephones. By delicate electrical instruments it is possible to chart the field electromagnetically The disturbances in the electrical field thus shown make it possible to locate ores because of their electrical properties

As most of the outcroppings of ore to the surface of the earth have long since been discovered, the new method is of great im-



Courtesy "Engineering and Mining Journal Press

How the ore body is located, using two movable electric probes connected with a source of several thousand volts, alternating current. If the rocks below the surface were homogeneous, the lines of equal voltage would be straight, (see upper half of drawing). If an ore body dies concealed, these lines are distorted by it, (lower half of drawing)



A cross-section of the new French Diesel engine for motor trucks

portance at this time, Dr Gavelin pointed out, because with the system, it has been found possible to locate ores at barren and rocky places where the existence of ores could not possibly be predicted by any other known method

The extent of the new find has not been determined, no borings having as yet "struck bottom" or penetrated through the ore One deposit was traced through ice to the bottom of a lake, thirty feet down. Besides gold, the ore contains silver, copper, sulfur, arsenic and iron The arsenic deposit is thought to be the richest in the whole world. Preparations for the construction of a railroad to Skellefted on the Baltic coast have begun.—*Science Service.*

* * *

Chromium on Printing Plates Saves Money in United States Mint

That a thin film of metallic chromium, electroplated upon a metal currency printing plate, would cause the plates to withstand the wearing action of the printing presses better than if the plates are made of the hardest steel, is the outcome of the tests of this process at the United States Bureau of Engraving and Printing Not only do the plates wear longer, but they cause the intricate detail of the bill designs to come more sharply into relief, thus afford ing further protection against counterfeiting

The method, worked out by chemists of the United States Bureau of Standards in collaboration with officials of the engraving bureau deposits a film of metallic chromium, thinner than an ordinary sheet of paper, upon a finished steel or copper nickel plate. After machining to sizes suitable for clamping on the presses, of which there are several hundred in daily service, the plates are placed in a special chromium plating bath Under carefully controlled conditions the deposits on the plates have a beautiful silvery lustre, the operation requiring, in the case of the nickel plates, only thirty minutes, and of steel, twice as long. Harder than the hardest steel, the plates yield from 50,000 to 100,000 impressions of eight bills each, and in some cases considerably higher numbers. An additional advantage of the method has been the discovery that after such a run, the chromium film may be removed chemically and a new film put on, thus obviating the necessity of making a new plate.

It is predicted that the method, already used to some extent on plates from which labels and similar commercial articles are printed, will find a much wider usage in the "shells" or electrotyper's plates from which books and periodicals are produced.—*Science Service*

* * *

Diesel Engine for Motor Trucks

What is stated to be the lightest oil engine built, weighing only 11 pounds per horsepower and consuming less than one-half pint of gas oil per horsepower is described in the August 3, 1926, issue of *Power* (New York) This is the Peugeot Tartrais engine, built in France A similar engine is about to be put on the market, says *Power*, for use—at least at first—in motor trucks.

The original engine was built late in 1922 and was employed immediately to drive a five-passenger touring car The mileage obtained was 14¼ miles per gallon of this oil, which, of course, costs much less per gallon than gasoline

The design proved so complicated as to make the production cost of the engine prohibitive, but after several changes, including the increase of compression to 475 pounds per square inch, the fuel consumption came out at 45 pounds per horsepower hour (One pound per horsepower hour is the ordinary fuel consumption of the gasoline motor)

A cross-section of the new engine is reproduced in these pages. The only type to be built at first is a two-cylinder, two-stroke cycle, motor truck engine, of 50 to 55 horsepower maximum at 1,400 revolutions per minute The bore is 4.73 inches and the stroke 5.906 inches.

* * *

Odd Boat Propelled by Pumps

One of the favorite dreams of the impractical, would-be inventor is the jet-propelled vessel In this type there is a tunnel extending forward and aft through the ship, and open to the water at either end. Some-

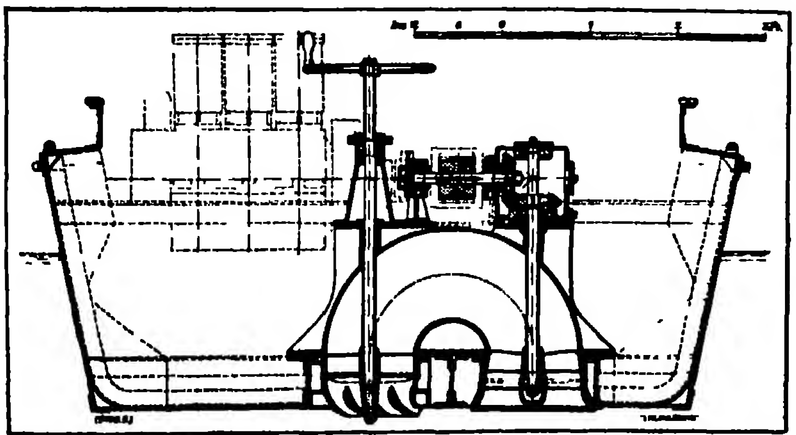
where in its length a pump is mounted and the ship is propelled by reaction from the current of water forced out behind. This method works but it is not as efficient as the ordinary screw propeller—that is the real fly in the ointment. However, such a craft has been built in England, for use under circumstances where the matter of relative efficiency is far outweighed by special circumstances.

"There are," says *Engineering* (London), "some exceptional cases of transport by water, when it is necessary to provide for a much greater flexibility in maneuvering than is usually obtainable with ordinary types of craft and propulsive machinery. Recently such conditions had to be met by a ferry boat for transporting passengers at the Royal Albert Dock, London, and a solution was found in an application of the Gill hydraulic propulsion system.

"It was found necessary in this ferry service to provide a small vessel capable of moving in any direction, either ahead or astern, and at any angle up to broadside on. A condition, which was imposed on the designers, was that the craft should be handled entirely by one man from a position at the forward end of the hull. No form of rudder, screw or other outboard projection was allowable, because of the liability of such devices to foul obstructions. The stipulation also was made that the boat should be able to work its way into very confined spaces, such as between barges and vessels at moorings or lying alongside the quay walls. Further it had to be capable of being held against quay-side steps or stages without the necessity for tying up. All the propulsion and steering mechanism had to be such as to be entirely free from possible troubles due to working in water encumbered with floating debris, ropes and other obstructions."

In these columns we reproduce from *Engineering* a cross-sectional drawing of the craft which was designed and constructed to fit the circumstances named above. The hull measures 30 feet by eight feet and is built of steel. It is propelled by a three-cylinder internal combustion engine which is outlined in the drawing. This engine is mounted athwartship and is geared to the vertical shaft of the pump by means of bevel gears. When the impeller at the bottom is rotated, the water is drawn up into the gooseneck tube shown in the drawing. It then circles up and around and issues from the deflection valve shown at the bottom on the left. This is simply a system of vanes for directing the outgoing current of water, and it can be swung entirely around in a circle by means of the handle shown at the top of its vertical shaft. By means of this handle the vessel can be maneuvered by one man. In fact the vessel described is strictly a one-man craft.

The boat has been tested and is said to be performing satisfactorily. "A considerable margin was found to exist over all the stipulations regarding speed, maneuvering and carrying capacity," says *Engineering*. "Satisfactory results were also obtained in regard to freedom from fouling among obstructions. In addition to the acceptance trials, tests were made to determine the dead pull exerted by the vessel when under power, with the complete range of running up to the normal duty. These tests showed that the old empirical rule that a pull of a ton should be obtained with tugs and similar craft for every 100 horsepower supplied to the shaft was complied with."



Courtesy 'Engineering'

Cross-section of the hull of the jet-propelled boat

* * *

Accidental Discoveries in Industrial Science

The story of how an Italian laborer, seated on a box eating his lunch in a plating plant, made a lasting contribution to his employer and to science, is told by Dr. William Blum, chemist of the United States Bureau of Standards and president of the American Electrochemical Society.

Officials of the company in question, makers of phonograph records, upon noting a marked increase in the hardness of the copper disks from which phonograph records are stamped, subsequently sent samples of the plating bath for analysis, which revealed that organic matter was present.

At a complete loss to explain the presence of any foreign matter in their electrolytes used for depositing copper electrically, a careful inquiry developed the fact that an Italian laborer had playfully flipped a piece of cheese at a fellow worker, the cheese missing its mark and falling into the tank where the metallic disks containing phonographic records were being plated. The phonograph company found that the hardening effect was due to the casein in the cheese, which material they therefore have continued to add to their solutions. The increased hardness of the copper allows a considerable saving because more records can be stamped in molten wax from the harder disks.

At another plant, in the research laboratories of General Motors, tests were being conducted to determine the cause of knocking in gasoline motors. One of the chemists conceived a brilliant idea: possibly knocking in motors was due in some way to the colors present inside the cylinder during combustion. Going to the chemical storeroom, he asked for some colored chemical soluble in gasoline. Out of some 10,000 at hand, the storekeeper gave him iodine, the only chemical in the lot which had the property of eliminating knocking! The color guess was wrong, but due to the happy circumstance of picking up iodine it was possible to solve the riddle of knocking in gasoline motors, and to work out the theory of anti-detonants which, it is believed, will bring about revolutionary changes in the design of internal combustion engines.—*Science Service*

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Automobile Exhaust Gas Harmful to Police

How much automobile exhaust gas does a busy traffic policeman inhale in a day? A little too much, according to tests made on over 30 patrolmen stationed at lively corners. Results of these tests, which have just been reported to the American Medical Association, are believed to confirm the pos-

sibility that such workers might be inhaling enough of the dangerous carbon monoxide gas to affect their bodily condition.

The investigation was conducted by Dr Elizabeth D Wilson, Dr H R Owen, and Miss Irene Gates, all of Philadelphia, Pennsylvania, and Wilfred F Dawson, of Galveston, Texas. They report that after eight hours spent close to automobile fumes, some of the traffic policemen had enough carbon monoxide in their blood to cause slight headache and quickened pulse rate In some cases, running up stairs was followed by dizziness and dimness of vision The carbon monoxide taken into the system is usually eliminated from the blood by the next morning, they find But they suggest that if the condition should become severe and troublesome it may be necessary for police departments to shorten the hours of duty in crowded sections of a city

The investigators state that in the past few years a number of traffic officers in Philadelphia have complained of headache, slight nausea, and muscular weakness at the end of the day after duty in the most congested mercantile districts of the city, and that these symptoms might be traced to carbon monoxide.—*Science Service*

Courtesy of the American Museum of Natural History

The tiny five-toed *Eohippus* of the Eocene Epoch, perhaps 55,000,000, years ago, compared in size with the skull of a modern horse

Man and His Horse—Whence?

Two new books which the reviewer treats together only because they were read together are "The Pedigree of the Human Race," by Prof H H Wilder (Henry Holt and Company, $3.25), and "The Evolution of the Horse," by Prof F B Loomis (Marshall Jones, $3 00)

New books about evolution keep on arriving, yet each seems to fill a previously unoccupied niche. Professor Wilder's book covers the evolution of man and his ancestors from the Permian Period reptile evolving into the ancestral mammal Its main stress, in fact, is laid on the early roots of man's evolution, down through the anthropoid stages, rather than on the already well covered subject of the early races of man proper This is a book mainly for two classes of readers those who have read popular books on evolution and thought them superficial, and those who have read scientific works on the early races of man and have thereby had their curiosity aroused concerning the various stages that preceded this phase of man's ancestry The book is not, in the main, elementary in treatment and the previous reading of even a little geology and zoology would doubtless render its pages more significant. The reader of rather studious tendencies will find this an invaluable mine of organized information from which to draw.

Professor Loomis' book on the evolution of the horse is considerably less of a study book than the above. "This volume," the author says in his preface, "is an attempt to describe in as simple terms as the writer can command, the story of the evolution of the horse. It is hoped to present the specimens and our ideas about them, so that the reader will have a picture of the whole history, and be able to place in it such details as he may find in museums, or in the wide open country" The reviewer believes that Professor Loomis has succeeded in realizing the hope thus expressed, for the language of his book is, in the main, non-technical and easy In fact, one obtains the impression that he is listening to an able but modest authority who might be seated on a veranda of a summer's evening, rather informally telling the fascinating story of the vicissitudes through which a little five-toed animal of the Eocene Epoch passed while evolving into numerous equine species, most of which are now extinct.

If anyone has ever wished that he could drop work and go west to dig fossils of horses and various extinct animals he will relish this book, for that is what its author has been doing for years. In it, he presents a clear picture of the methods by which this romantic quest is performed. Since the evolution of the horse is known better and in more detail, than that of any other animal except possibly, the camel and the elephant, it can be truthfully said that Professor Loomis not only knows how to tell a plain story but has a real story to tell.

In each of the works mentioned above there are a few slips, but they are comparatively too trifling to mention, in view of the general excellence of the rest

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A New Springfield Telescope Mounting, Large Size

Those of the amateur telescope makers who have taken interest in the so-called "Springfield" type of mounting for telescopes having a fixed eyepiece, will doubt less be further interested in the telescope of that type recently constructed by Donald Alden Patch of 38 Crescent Street, Springfield, Vermont Mr Patch is a new initiate of the "Telescope Makers of Springfield."

Mr. Patch and his large Springfield equatorial mounting

A photograph of his telescope is reproduced in these columns.

For the benefit of those who have not already become inoculated with the "bug" of amateur telescope making, an explanation of this type of mounting is in place. The light from a star passes down the open tube, and is reflected up again from a mirror at the lower end Due to the concavity of this mirror, the light returns as a cone which in the present case would reach a point about even with the open end of the big tube. However, in this type of telescope a small prism with a diagonal face is rigidly suspended inside of the tube, in line with its axis. This prism turns the cone of light at right angles. A second prism placed directly beneath the eyepiece tube (which shows in the illustration), receives and again turns the diminishing cone of rays

upward directly into the eye of the observer

The virtue of this arrangement is, that no matter what the position of the tube, the prisms send the image of the star to the eye of the observer without forcing him to contort his body like an acrobat. He is always looking comfortably down, as if through a microscope. This type of mounting was originated by Russell W Porter of Springfield, Vermont, and several satisfactory telescopes that work on this principle have already been made. For example, one of the smaller size having a six inch mirror is shown on page 212 of the September issue of the Scientific American.

Mr. Patch has now completed a mounting of the original Springfield type but heavier, permitting the use of a ten-inch or a twelve-inch mirror The sketches on pages 32-33 of "Amateur Telescope Making" show this size. Mr. Patch posed as the model for these sketches when they were originally made. His present mirror is 8½ inches in diameter, and its focal length is 60 inches. The mounting is made of cast iron, although bronze castings may be obtained. The blueprints of this larger size of Springfield mounting show little variation from those of the smaller size, the principle being the same in each case. The rod which extends to the left carries a counterweight which could not be included in the picture.

Numerous inquiries concerning the manner of subdividing the setting circles of small telescopes having reached the editor, it may be said that ordinarily, the declination circle should be divided into single degrees and the polar or hour circle into 15-degree divisions, each of which is again subdivided into six equal parts. Since the earth revolves 15 degrees in 60 minutes of time, these 15-degree divisions correspond to one hour, and each of their six part subdivisions corresponds exactly to ten minutes of time.

Mr Patch's telescope is solidly mounted on a concrete pedestal but may be taken in at night. He has run a duplex electric light wire through a buried conduit to the pedestal, and thus he has light at the telescope when he needs it A telescope of this general size will magnify from about 60 diameters (using a one-inch eyepiece) to 120 diameters (using a one-half inch eyepiece) under atmospheric conditions obtaining in the east. In parts of the west where the atmosphere is not so hazy, a stronger, one-fourth inch eyepiece giving 240 diameters, could safely be used Occasionally, this size may be used in the east

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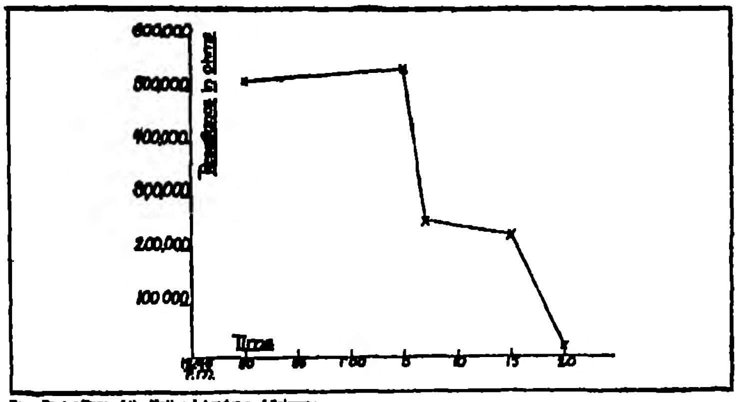
Sleep Tested Electrically

THAT the electrical resistance of the body is markedly increased during sleep and that the quality of our sleep may be measured and studied experimentally by electrical methods, is the remarkable discovery made by Dr Curt P Richter of the Psychobiological Laboratory at Johns Hopkins Hospital (Baltimore) and described in the March, 1926, *Proceedings of the National Academy of Sciences* (Washington) In one case the onset of sleep automatically raised the electrical resistance of the body from 80,000 ohms to 500,000 ohms.

Our knowledge of the changes which take place in the body during sleep is still very limited, says Dr Richter Although there has been almost no experimental investigation of sleep, it has been the topic of an almost endless number of theories and speculations Scientists knew—or rather thought they knew—that the depth of sleep reaches a maximum before the end of the second hour, and then rapidly decreases again to a low level, at which it remains, with small fluctuations, until the end of the sleep period

We have all heard statements similar to the above, but Dr Richter characterizes them as fallacies. When the tests from which this fallacy took growth were made, years ago, the subjects were constantly under a strain, waiting to be awakened, and accordingly the sleep was never normal Dr Richter avoided this factor in his experiments. His records were obtained by measuring the resistance offered to the passage of an imperceptible galvanic current from one hand to the other, using special zinc electrodes, covered with paste made by mixing kaolin with saturated zinc sulfate solution These can be easily attached and removed, usually without interrupting sleep. The resistance was measured with a string galvanometer

By means of the equipment described, Dr Richter demonstrated conclusively an unusually interestin, fact—that the resistance is localized almost entirely in the skin of the body A puncture through the skin with a needle, even the finest, reduces the resistance instantaneously practically to zero As shown in the graph reproduced, the resistance measured from back of the left hand to back of the right hand, remained steadily at over 500,000 ohms from 12 48 P M to 1 05 P M At this instant, a hole through the skin of the left hand caused a drop of 250,000 ohms. At 1 16 P M., a hole punctured through the skin of the other hand caused a drop to 15,000 ohms.



From Proceedings of the National Academy of Sciences

How the nerves control electrical resistance

Further experiments on monkeys, in which the nerves to the hands and feet were cut, demonstrated that the resistance of the palms of the hands and feet is dependent upon and is regulated by nervous impulses (although the backs of these extremities show no such relation) When the nerves were cut, the resistance jumped from 40,000 ohms to 990,000 ohms.

Some people sleep lightly, others can be awakened only by a thorough pummeling Both types were tested, with the discovery that the resistance of the body is a true and corresponding test of the *depth of sleep* That is, those that respond to slight noises with changes in breathing, sighs and so on, showed low resistance during sleep Those who were oblivious to all disturbances maintained high resistance

Awakening, however sudden, brings an instant drop in resistance Dr Richter writes "Several similar observations were made on a monkey, which, while held in the lap of an assistant in a darkened room slept fitfully The resistance followed the change in sleep so closely that it was possible to state quite accurately, without seeing the animal at all, whether it was awake, drowsing, or asleep, simply on a basis of the resistance readings."

With the typical true scientist's caution in the interpretation of results, Dr Richter says it is not yet known whether in sleep

we deal with an interruption of the nervous impulses, or with the effect of an inhibitory process The results obtained with the skin of the back of the hands varied with the persons under test, and this suggests that there are two kinds of sleep, a quiet, relaxed sleep, and a strained sleep with muscular activity

• • •

In Fond Memory of a Faithful Pair of "Pants"

How a prospector made a canoe out of his own trousers, and, trouserless, braved the incessant torments of the indefatigable arctic mosquito, in order to save himself from sure starvation, is the amusing account sent us by a reader from Alaska

Last summer this young mining engineer set out from Fairbanks, in the interior of Alaska, for a prospecting trip in the heart of the Arctic Mountains, several hundred miles north of that far flung center of civilization The upward trip was made by airplane, motor boat, canoe and raft, as well as with the aid of Indian packers and malamute dogs

Faced with the alternative of starving if no transportation facility could be found, a handy prospector constructed this canoe, *Faith, Hope and Charity*, covering the framework with numerous "et ceteras"

This view of *Faith, Hope and Charity* shows the interior and the constructional details of the boat

After several weeks in company with an Indian chief and the four dogs, prospecting for gold in the long range of mountains that borders the Arctic Ocean, the "grub" supply of the party gave out If they were not soon to starve, a hasty return must be made. Not wishing to sacrifice their valuable dogs for food it was decided that the Indian, with the few remaining pounds of food, should retrace the journey on foot as far as Arctic Village. The white man would attempt to go by water, and since it would be a down river journey, he should be able to do without much food.

But how to obtain the necessary canoe? Boat making materials were not to be had in this barren country Yet a craft of a sort—not beautiful, not especially seaworthy—was hastily made

The ribs and strakes were of willow saplings tied together with grass. Over this framework was stretched a sort of patchwork or "Joseph's Coat," consisting of the following one sun-shade, one "parka," one pair of overalls, and one pair of underalls. These sundry garments and fabrics were all sewed together and then daubed with caribou fat in an effort to make them waterproof The resulting sheet was then attached to the outside of the willow framework.

In this shaky craft the plucky adventurer started on the long trip down the notoriously turbulent Sheenjak River

After many days of peril and privation, and especially of constant, trouserless battle against the innumerable hordes of mosquitos that infest the far north, the hungry prospector finally reached the Yukon and a civilized community For the most part, he says, he was clothed in a black beard and a head net

Food was his second request, his first was for a pair of "pants."

• • •

Oranges Make Bones

WHY is it that modern, intelligent mothers feed their children orange juice? Because orange juice contains noteworthy amounts of vitamins, A B and C The lack of vitamin A leads to rickets and a lowered resistance to tubercle and other infections. The lack of vitamin B leads to the disease known as beri beri A deficiency of Vitamin C leads to scurvy

Work performed at the University of Chicago last year showed according to the *Journal of the American Medical Association* (Chicago), that children who were fed supplementary school hour meals which included oranges gained in weight to a far greater extent than could be accounted for by the value of the food fuel derived from the 20 to 23 ounces of unstrained citrus fruit juice administered daily

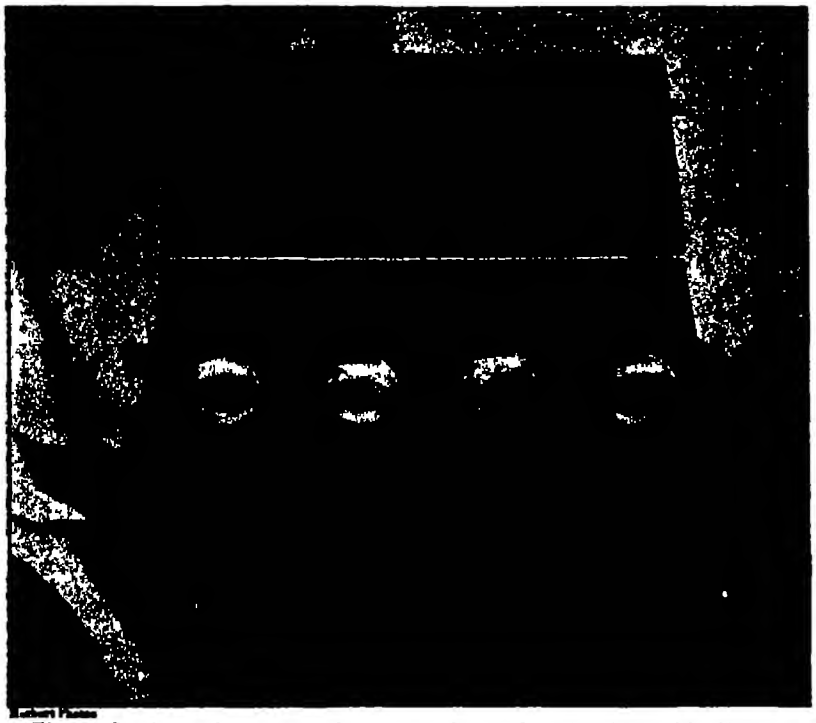
It was noted that calcium assimilation was decidedly benefited when oranges formed a part of the diet, *the increased retention being considerably greater than the calcium in the oranges* (Calcium is a bone-forming element) The increase of phosphorus retention was even more marked than that of calcium, more than three times as much phosphorus being assimilated when orange juice was added The magnesium retention was also increased

What, then, is the significance of these remarkable statements, which on first thought do not even seem reasonable? How could more calcium, phosphorus and magnesium be assimilated than the orange itself contains? There is some as yet unknown or half understood effect which the vitamins produce, by which, in their presence, bone-forming elements may be absorbed from other foods. Various theories have been advanced to explain this, but these should possibly not be advanced outside of medical journals at present. Until more definite knowledge of the causes is settled on we must rest content to know the fact, which is undeniable, that orange juice does greatly aid bone formation. Also that without oranges or some other food containing vitamin A, no amount of calcium stuffing is effective.

Radio Notes

A Review and Commentary on the Progress in This Branch of Rapid Communication

Conducted by Orrin E. Dunlap, Jr.



This is the four-tube receiver designed to be used on René Fonck's ill-fated attempt to fly from New York to Paris

Dirigible Helps Radio Calibration

EXPERIMENTS conducted with the dirigible *Los Angeles* when flying along the Atlantic coast have shown that this type of aircraft is valuable as a means of calibrating radio compass stations. The dirigible is better adapted for the calibration of the radio direction finders than airplanes, according to the Navy Department, because it is steadier and can maintain flight for a greater period of time, at reduced speed if necessary. These factors increase the efficiency of the radio calibrations, which consist of checking the direction from which the radio waves come against an actual visual bearing of the compass station taken at the same instant. A series of the radio and visual bearings are plotted and from this data the error of the compass on every degree around the circle is computed.

The big airship conducts the calibration tests by flying around in circles within a 15-mile radius of the direction finder. The radio compass coil is at the center of the circle. The transmitter of the dirigible is operated continuously, sending a series of dots and dashes, while an observer at the compass station records the time of transmission and the bearing. Another observer is stationed close to the compass coil or antenna. This man takes the visual bearings of the airship and from the two sets of data obtained by these observers, curves are drawn which reveal any errors of the radio compass.

More Power for WLW

AN order for the first 50-kilowatt broadcasting equipment to be manufactured by the Western Electric Company has been placed by the Crosley Radio Corporation for use at station WLW, Cincinnati, Ohio. The management of the station reports that the transmitter and a new fireproof building in which it will be installed, will cost about 250,000 dollars. This installation will rank WLW among the most powerful broadcasters in the country. Two other 50-kilowatt sets are in operation at Bound Brook, New Jersey, and Schenectady, New York.

Radio in Spain

REPORTS from Spain indicate that the outstanding features necessary in radio sets in that country are selectivity and ability to tune-in distant stations. The Madrid station, the most powerful in Spain, is tuned to the 392 meter wave and London is on 365 meters, so a good criterion of a receiver is its ability to tune out Madrid and pick up London without any interference. Bournemouth is another transmitter close to Madrid's wave. It operates on 385 meters and it requires a good receiver to separate the two stations.

The Spanish sets use tubes manufactured in Spain and known as "Castilla" detectors and amplifiers. The Dutch make of Phillips tubes are also used in Spain.

Ninety-five percent of the radio apparatus used in Spain is imported from England, Germany and other sources, according to the Secretary of the Spanish Wireless Association.

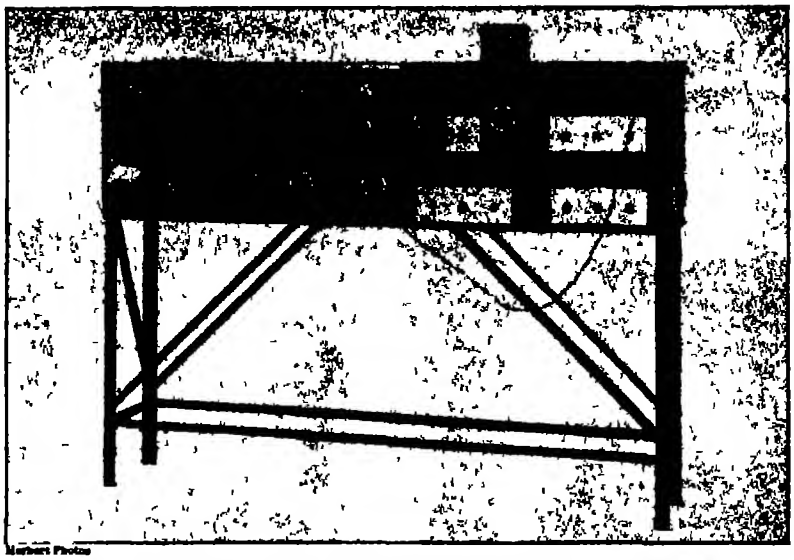
In developing a broadcasting system, Spain seems to be opposed to one built upon American, British or German lines and the popular slogans of radio fans are reported to be, "No monopoly," and "Freedom of Broadcasting."

New Project for Radio

THE British Broadcasting Company has formulated a plan, which has enlisted the interest of the Royal Colonial Institute, for inter-empire broadcasting of education and entertainment, through a chain of world-wide radio stations, which will reach an audience of 400,000,000 people.

According to Major Gladstone Murray of the British Broadcasting Company, the contemplated system would involve an expenditure of 3,000,000 dollars which could be raised by inducing all the constituent parts of the Empire to adopt the English system of paying for receiving licenses.

The powerful transmitter at Daventry, England, is mentioned as the starting point with Moncton, New Brunswick, 2,440 miles away as the first relay station. Other Canadian broadcasters, aided by land wire re-



Herbert Photos

Marconi's new recording receiver. This set, used for high-speed wireless, is built in units. Top row from left to right: direction finder, tuning unit, control panel, oscillator generator and low-frequency filter. The lower row, left to right: search coil, two high-frequency filters, high-frequency amplifier and detector and direct-current bridge. Five models cover wavelengths from 450 to 50,000 meters

lays, would carry the programs across Canada and at the same time radiate them into space for Canadian listeners. At Vancouver the programs would be flashed to Australia, and from there to Colombo, Ceylon and Cape Town, South Africa. Colombo would be used to send the broadcasts to Bombay, India and Malta, thence back to Keston, England. Eight high-power stations would be involved in the project, as well as eight special receiving stations, six repeater stations and local broadcasting stations in the various countries.

For Greater Safety to Shipping

ELEVEN new radio beacons will be ready for service by June 30, 1927, to protect shipping along both coasts of the United States, the Gulf of Mexico and the Great Lakes, according to information given by the Department of Commerce to Dr. Frederick A. Kolster, inventor of the radio compass. The Kolster compass is used on ships in conjunction with radio beacon stations to give accurate bearings without depending upon visibility.

The United States Government is now operating 27 radio beacons, which is more than the total of all other foreign countries. Nine stations are in use along the Atlantic seaboard, nine on the Pacific coast, seven on the Great Lakes and two on the Gulf of Mexico. An additional score are awaiting the appropriation of funds.

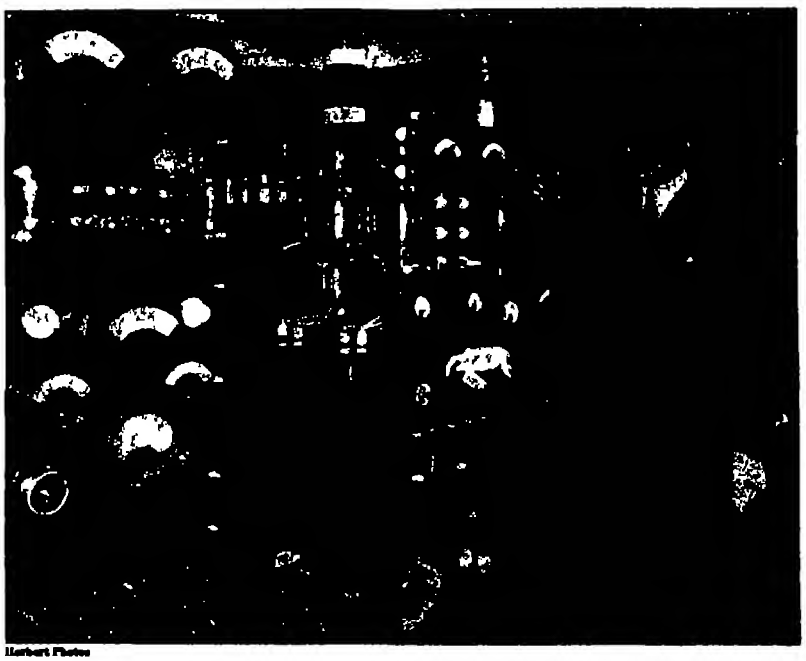
The beacons soon to be placed in service are the Stratford Shoals lighthouse, New York, Winter Quarter Shoals Lightship, Virginia, three in Florida on the Gulf coast; three in Michigan and one in Wisconsin for the Great Lakes and two along the Atlantic.

Approximately 300 American passenger and naval vessels are equipped with the radio compass and foreign ships are rapidly adopting the direction finders. The Kolster compass was first used on a passenger ship in 1922.

Radio Equipment for Press Club

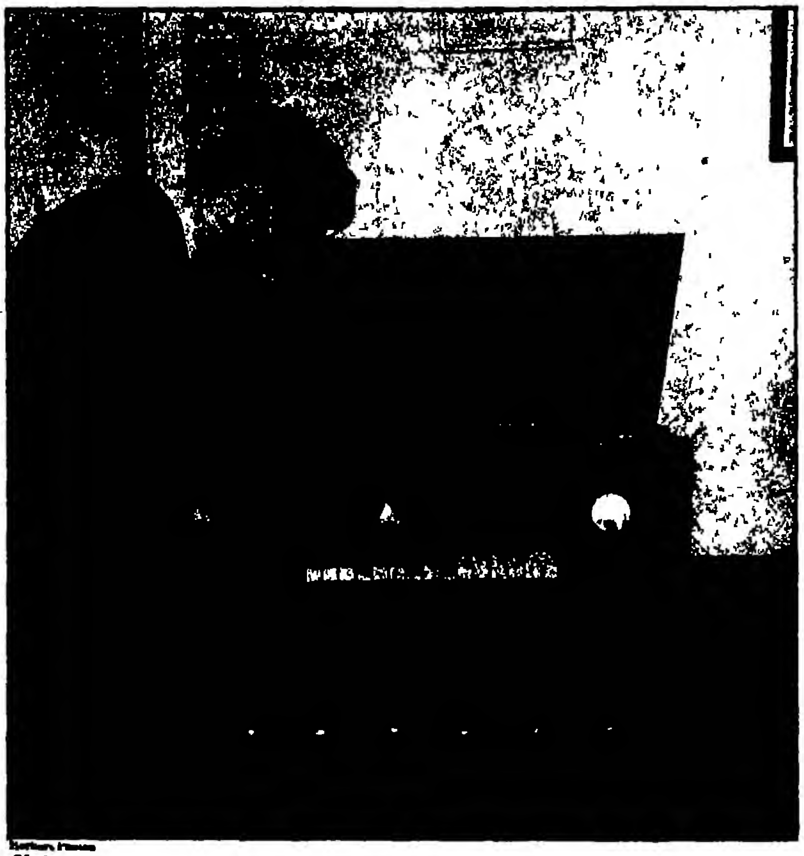
A SPECIAL committee has been organized to plan and supervise the installation of radio equipment in the new 11-story, 10,000,000-dollar National Press Club Building at Washington, D. C. It is planned to "pipe" music and talks to various rooms through out the structure so that press correspondents in the building may follow news events, such as a speech by the President of the United States, the proceedings of an important dinner, a dedication or other functions.

A radio central will be located in the club proper, which will occupy the two top floors and from that point programs will be routed to loudspeakers or headphones in the main



Herbert Photos

Marconi's floating laboratory. The well-known inventor of wireless does much experimenting aboard his yacht *Elettra*



Utilizing the radio squeal. The "pianorad" consists of a keyboard of 26 keys, each of which, when pressed, causes a vacuum tube to oscillate at a desired pitch. The music is said to be clearer than the tones of a flute because there are no overtones. The instrument is installed at WRNY

club room, dining room or ladies' room. An experienced operator will be in charge of the equipment.

Facilities will be provided for microphone connections in case it is desired to broad cast notable events from the club.

Valuable Franchise

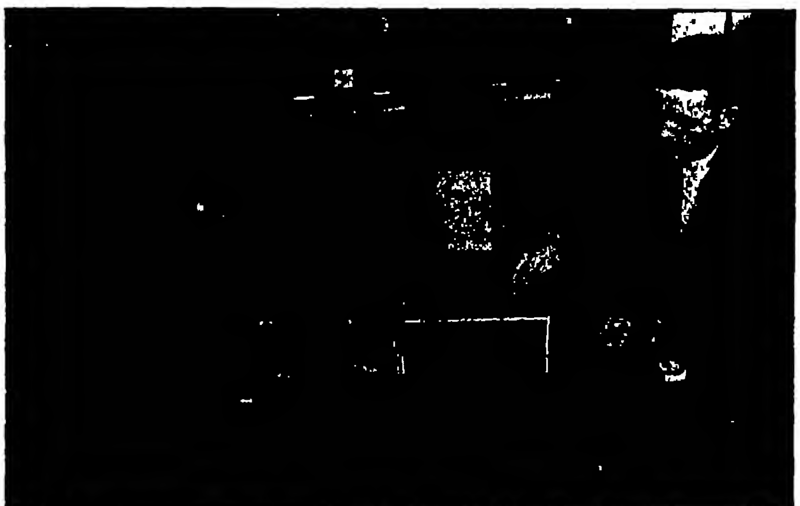
SAMUEL PICKARD, chief of the radio service of the United States Department of Agriculture, after a 10,000-mile tour covering the eastern half of the country, during which time he visited many broadcasting stations, said that he believed every college with a radiophone transmitter and a good wavelength has a million-dollar franchise.

Mr Pickard said that he lamented the fact that many institutions are putting less money, thought and talent into their college stations than they merit. He pointed out that in this new endeavor, the college is in competition with broadcasters spending large sums of money for talent, and that if the agricultural agencies expect to compete for their share of the "countless millions," they dare not bore the radio audience with mediocre programs He said that for effective extension work, the programs must be directed away from academic lectures toward the dramatization of facts.

Revising a Formula

TESTS are being conducted by the radio division of the Bureau of Standards in an attempt to revise the constants of the Austin Cohen transmission formula, which was evolved to measure the electric field produced by radio signals over long distances. The experiments are being made with the hope of obtaining more correct values from the application of the formula under present conditions and at greater distances

Observations made in recent years reveal that the formula worked out several years ago gives too low values for signal strength There are difficulties attending the experiments because of the many disagreements in the measurements of different observers, especially at distant points where the signals are feeble



The Bureau of Standards has designed this portable radio beacon for calibrating direction finders on board ships. It is a miniature broadcasting station that can be transported from place to place

Courtesy Radio Corporation of America

Ease of tuning and ample volume of reproduced voice and music are the outstanding features of this type of radio receiving set. The centralized tuning controls now so popular are located in the center of the panel. The loudspeaker is of the cone type and is shown on the small table to the immediate left of the set

Die-cast Condenser

A CONDENSER of new design made by the die-cast method, with rotor and stator blocks built as two complete sections forming the main structure, has been introduced by the Unicontrol Condenser Corporation

An accurate and smooth surface is obtained by the use of an alloy of aluminum, copper and silicon The straight line frequency effect is made possible through tapered circular segments without the usual offset plates, which are generally used by other manufacturers to gain the same result The complete condenser consists of 12 parts, the bulk of which are about one half of other condensers of the same capacity The interleaving plates rotate parallel to the axis of the condenser

The shaft is of novel construction and cone bearings have been substituted for the cylindrical bearings usually used in variable condensers One of the bearings is of the semi floating type, held under spring tension to compensate for any wear on the bearings. The engineer who designed the instrument points out that the main advantages of the condenser are durability, and no "end play" or "side play" when the dial is turned, no matter how long the device is in service.

Broadcasting Maps

TESTS being made at the United States naval radio station NAA, at Arlington, Virginia indicate that ere long weather maps will be transmitted by radio to ships at sea The weather charts furnished by the Weather Bureau are radiated into space in much the same way that radio photographs are broadcast At the receiving stations, an ink stylus operating in connection with a cylindrical drum traces the lines of the map on a blank sheet of paper and the completed picture shows the isobars, barometric highs and lows and other information that is generally found on weather maps.

The system is the invention of C. Francis Jenkins of Washington who is noted for his experiments with radio motion pictures and television

Those conducting recent tests explained that, to receive the charts, ships must be equipped with radio-map receiving instruments. Lack of dark room facilities on board vessels, necessary for radio-photography, is the reason why the pen and ink stylus process is used for broadcasting maps to sailors, according to the experts at Arlington

It now requires about 45 minutes to transmit a complete map but it is expected that the perfection of the process will reduce the time required to about 15 minutes.

Automatic Control of Transmitter

To avert interruption of program service resulting from break-downs in the apparatus, the automatic operation of a radio transmitter has been developed by engineers at station WGY, Schenectady, New York An ingenious system of 15 relays, operated over three lines between the control room and the transmitter, govern the apparatus which is a quarter of a mile distant There are also interlocking relays which automatically control the flow of water used for cooling the high power tubes.

A Mobile Tester

S. W EDWARDS, radio supervisor at Detroit, has an automobile equipped with a Kolster radio direction finder and testing devices which enable him to take bearings and locate stations operating contrary to government regulations. The car has already covered 15,000 miles and has saved more than $1,500 in railroad fare, according to Mr Edwards. The car cost $4,500

9DOZ Awarded Medal

C. B HARRISON, owner of amateur station 9DOZ at Belleville, Illinois, has been awarded the Popular Radio medal for conspicuous service where "prompt and efficient action is utilized to perform an essential part in the alleviation of human suffering or in the saving of human life."

Operator Harrison sent out an SOS call when a tornado wiped out Murphysboro, Illinois, and surrounding territory in March, 1925 As the result of the broadcasts from 9DOZ, relief was rushed from Chicago to the stricken area.

Experimental model of a "B" battery eliminator designed by Rutledge Mayo to supply voltage to the receiver from 110-volt alternating-current mains

Line-o-Light Tuner

A NEW model receiver, known as the Amborada, consisting of a seven-tube circuit, completely shielded and encased in a walnut cabinet has been introduced by the American Bosch Magneto Company Above and in the top of the table surface, is a flush window through which the new "Line-o-Light" tuning system is viewed. A translucent drum-type scale is calibrated in wavelengths and from the under surface of the drum, a sharp line of light is thrown across the scale, lighting the exact wavelength to which the receiver is tuned.

Five condensers, each tuning a unit in the radio-frequency amplifier, are mounted with their shafts end to end. The coupling between the condensers allows for minute differences in shaft alignment and counter balances facilitate tuning the condensers.

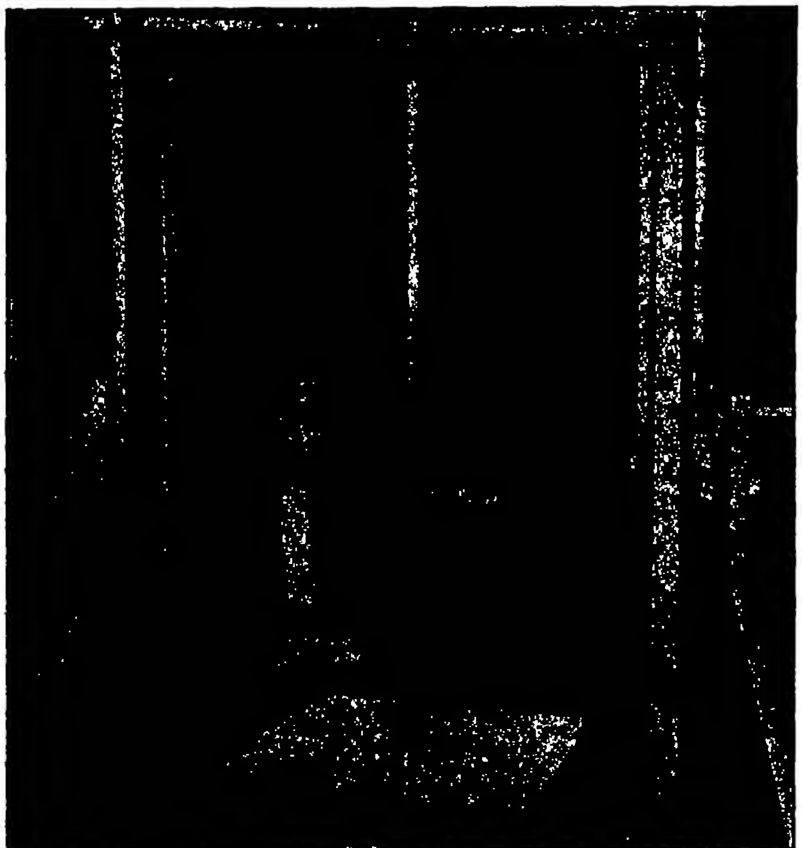
Space is provided in the lower part of the cabinet for all power accessories, including "A" battery, power unit and charger

Short Wave Tests

THE Naval Radio Research Laboratory at Anacostia, D C, is cooperating with 40 stations scattered over a territory of 7,000 miles in making tests on the 25 6-meter wavelength. So far it has been found that the 25.6-meter signals are not audible in daylight within a 500-mile radius of the transmitter, but that the intensity is good in the zone between 700 and 1,200 miles, and that from 2,000 to 3,000 miles the waves seemed more uncertain than within the 2,000-mile region

Colleges Organize

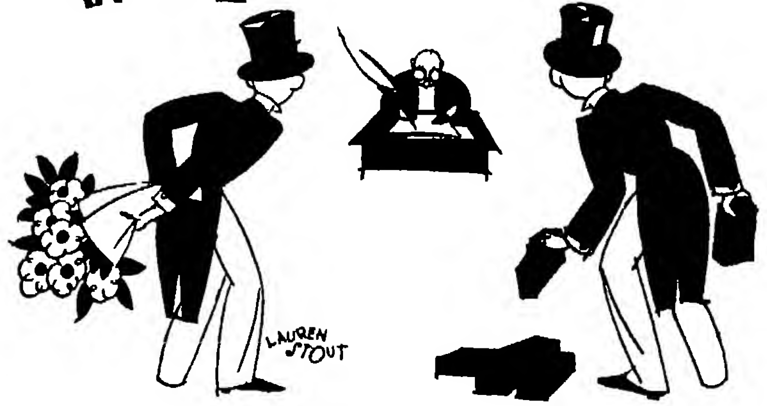
A COLLEGE and University Association of Broadcasters has been organized under the direction of C. A Culver of Carlton College, Northfield, Minn., and J C. Jensen of Nebraska Wesleyan University at University Place, Neb The purpose of the organization is to safeguard and extend the educational features of radio broadcasting.



Wide World

Dr. Lewis W. Martin, chief of the laboratory for special radio transmission research of the Bureau of Standards, making observations with his double-axis receiving loop, which is used in the study of the direction changes of radio waves

IN THE EDITOR'S MAIL



A Reminder from the Past

Many parts of this country are rich in relics of Indian tribes that have long since passed to the "happy hunting grounds" leaving only a few scattered survivors to remind us of a race that once held sway over the entire United States One of our readers has sent us some information on an old dug-out canoe, together with a photograph of it We print the text of his letter below and the photograph will be found reproduced in these columns

Editor Scientific American

The poet who wrote about the upturned canoe on the lonely shore and the memories it brought back to him would have been delighted to find the old canoe shown in the photograph which could it speak would reveal many secrets of the time when its owner some red skinned aborigine glided along the Muskegon River in pursuit of a deer he had driven into its waters or perchance on his way to the regular pow wow at Maple Island twenty miles down the river

The old canoe was found by three men who own land on the river front two miles below Newaygo Michigan They were digging a log out of the bank when they struck the canoe and curiosity prompted them to continue digging until they had it uncovered It measures 16 feet long 19 inches wide and seven inches deep on the inside Made from Norway pine it is very rough, being fashioned entirely with an axe the deep marks of which are still visible It is probably between seventy and eighty years old and is in almost perfect preservation being still serviceable A cave in of the bank evidently covered it and the wet sand preserved it intact

There is no doubt of its Indian origin The place where it was found is the site of an old Indian village Before the war of 1812 there was an Indian trading post on Muskegon Lake kept by a half breed Frenchman He made frequent trips up the river and the site where the canoe was found was a favorite camping place Here there is a perfect horseshoe bend in the river In the 40's a trading post was established and soon a large Indian village clustered around it The habitations ranged all the way from bark tepees to log shacks

When the lumbermen invaded the country and began using the river to float logs the Indian shacks on the flats had to be moved to the higher ground further back Here the Indians lived for many years trapping and making baskets which they sold in the lumber towns that sprang up near by With the coming of the farmer, the trapping grounds became depleted and most of the Indians moved farther north A few of their old shacks still remain but of the large Indian population only three families are left When the last of these shall have passed away the old canoe will remain for the future generations of white people to meditate upon as a memento of a vanished race

Harry L Spooner,
Detroit, Michigan

More on the 5-5-3 Controversy

We want accuracy first last and always and thank Mr McMichael for his letter which arrived in the midst of the battle over the 5-5-3 controversy

Editor Scientific American

In the recent article on the 5-5-3 controversy by Capt Dudley W Knox, there are several inaccuracies which I cannot pass without mentioning

Capt Knox states that the British have only four coal burning battleships They have nine viz *Thunderer*, *King George V*, *Ajax*, *Centurion*, *Tiger* (*B C*), *Iron Duke*, *Marlborough*, *Benbow* and *Emperor of India*, the first four of which will be replaced by the *Nelson* and the *Rodney* oil burners Capt Knox correctly states that the six Amer

Reminiscent of the days when the Indian roamed the plains and hills of this broad country is the dug-out canoe illustrated above

This fine photograph of lightning flashes was submitted by one of our readers. The vertical flashes traveled upward, not downward

ican ships carry less reserve oil, but then they have a greater normal coal supply than corresponding British units.

Now as to the matter of bulges. Special appliances would have to be used to shift the oil or water quickly and that would have to be done long in advance as at present the oil could not be shifted from one tank to another fast enough to meet a sudden emergency in battle and to add these appliances in advance would be contrary to the spirit of the Washington Conference, by which the maximum elevation of the guns was understood to be settled Even if fitted, it would not be a very great advantage, as speed would be lost and speed is everything in a modern action Very likely a large quantity of ship s oil would have to be pumped overboard in this operation

Capt Knox first counts the "Queen Elizabeths" as blistered ships (because they will be in the near future), then later credits them with a superior speed, viz:

"The nine fast British ships,".

Four he means, of course to be the battle cruisers, and the other five I presume, he means to be the "Queen Elizabeths" If fitted with bulges, their speed would not be materially greater than the other battleships, and would hardly be used in conjunction with the battle cruisers. Except for the four battle cruisers, the British ships have, or will have, about the same speed as the American ships.

The American battleships as a whole are newer, and better protected so that if the six oldest have certain faults I think they are more than made up for in the other ships.

Hoping to see more on this subject in your excellent magazine I remain

Yours very truly,
R C McMichael

Mistaken

In our May issue, page 326, we stated that Mr J C Vredenburg was one of the inventors of Pollopas, a new organic glass which may be bent The following communication has been received from Mr Vredenburg

Scientific American
Gentlemen:

I was today shown a small article in your May issue in which my name was given as joint inventor with Dr Fritz Pollak of Vienna of a glass substitute that will bend. I do not know whence this information emanates, but would like to point out that your mention of myself as co-inventor is not correct, the inventors being Dr Fritz Pollak and Dr Kurt Ripper, both of Vienna My own interest in the proposition is that of the inventor's financial representative

J C. Vredenburg

Lightning Strikes Up!

Most people, if asked to express an opinion as to the direction in which lightning travels, would answer that it goes from the cloud to the ground In some cases, they would be right but it so happens that often the direction of flow is from the ground to the cloud. The following letter draws attention to this fact and the writer of it was kind enough to forward a photograph of a lightning storm Because it is a good one and interesting we reproduce it in these columns.

Editor Scientific American

The article on page 133 of your August number reminded me very much of the storms we get in this part of the country and of the damage they sometimes do.

Here is a picture taken of a lightning storm that passed by Frederick, Oklahoma The exposure was for six minutes. The vertical flashes in the center of the picture traveled from the ground to the cloud, not downward as is the direction in which most people believe lightning always travels

Although the surrounding country was bombarded with many lightning hail and rain and wind storms during the month of July, Frederick got but a few sprinkles all of the storms going around as shown in this photograph

Douglas W Young
Oklahoma City Oklahoma

About Road Corrugation

The cause of road corrugation bids fair to assume the proportions of a large size controversy The opinions so far expressed differ from each other somewhat and in all cases, facts are cited that at first glance appear to be irrefutable Possibly the crux of the whole matter lies in the fact that there is more than one cause for this annoying formation found on some of our roads In some cases, with certain types of road surface, the constant action of automobile traffic may be the sole or a contributing cause In other instances, the method of repairing the road surface may be at fault In any event, several of our readers have studied the situation and two of the best letters received to date are reproduced below Both of these parties are firm in their convictions that road corrugation can be traced directly to one source but in both cases, the reasons put forth are different This is a question that seems to be of immediate interest to many of our readers and if a satisfactory solution can be reached, one more controversy will be settled The first letter blames traffic for holes in the road but not for corrugation This reader finds fault with the methods of road repair in general use but offers constructive criticism.

Editor, Scientific American

I was very much interested to read the opinion of Mr R I. O'Neill, of Nogales, Arizona, as published in the September number, regarding the cause of the "wash-board" effect on gravel roads.

In Michigan we have many hundred miles of trunk line highways of gravel construction, on which various forms of scrapers are used to maintain the surface I have made some study of this system of maintenance in this region and my conclusions may be of interest as supplementing the opinions of Mr O'Neill.

In wet weather much damage is done by the pounding of high speed traffic, due to the "unequal hardness" of the surface caused by the unavoidable variation in the quality of the gravel, but the holes thus formed are irregular, both in size and spacing. Some damage of this

nature is also caused by the traffic in dry weather, but the "wash-board" effect is caused almost entirely by the scrapers and this is done in two ways. First, as Mr O'Neill says, by the spring or chatter of the scraper blade and second by the fact that the angle of the scraper blade and the direction of travel are almost never changed As, day after day, the scraper goes over the road in the same direction and with the blade at the same angle, small ridges are formed and as the wheels of the machine pass over these each trip, the blade is raised and lowered, digging the corrugations deeper until the "wash-board" can easily be seen and more easily felt, the ridges extending from the center of the road toward each gutter at the angle of the scraper blade. The regularity of these corrugations causes the terrible vibration which is so annoying to the motorist, and so destructive to his car

This trouble can be easily avoided if the angle of the scraper blade is changed each trip and the direction of travel frequently changed, thus cutting off any ridges or "humps" instead of rising over them and making them larger Also, a form of "planer" having two or more blades set at different angles will prevent the formation of these regularly spaced ridges.

Ross F Hammond,
Olivet, Michigan.

The second letter on this interesting subject blames the traffic for the road corrugation Here it is. Is Mr Brodsky right or is the solution put forth by Mr Hammond the correct one? More study may bring forth further facts.

Editor, Scientific American

The question of road corrugation has been touched upon in your magazine and a correspondent from Arizona lays the blame on road scrapers. In his opinion the automobile has nothing to do with it

However the corrugations come before the road scraper is applied and appear again after the road has been used for some time by automobile traffic, so that obviously, that traffic must be held to account for the deterioration of the road though the methods of road building and repairing may be faulty and inadequate

I have carefully noted the changes in the surface of some roads in my neighborhood which I use frequently and my observations show that regular corrugations appear most distinctly on light tarred roads with an excessively thick layer of tar, binding almost pulverized stone.

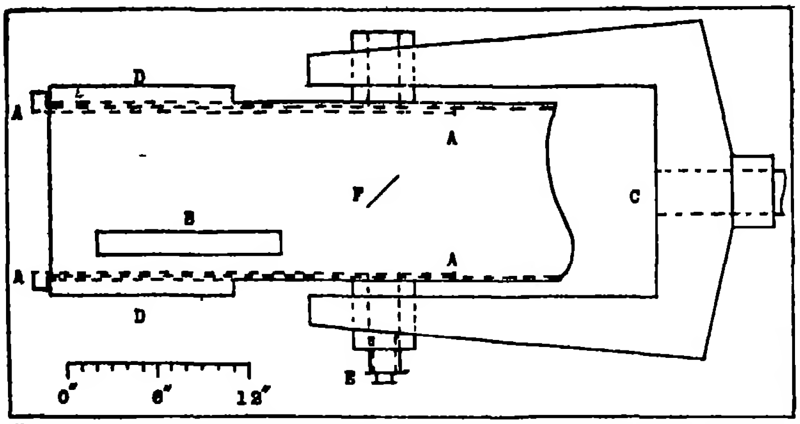
It is a well known fact that tar, or pitch, is semi fluid and the formation of waves, or crests and depressions, in it under repeated impact in one direction is very similar to those made by a stone cast into the water of a quiet pool The element of time bears a different relation to the effect of impact on tar and the action of the wheels, after the initial crest has begun to form, is apt to change somewhat the similitude.

A single rut on a horizontal road will start a series of corrugations along the entire length thereof Vibrations set up by the passing of trolley cars help considerably towards the formation of corrugations, as they keep the surface in a state of instability, loosening the foundation.

The action of brakes on hills is responsible for irregular corrugations due to the dragging effect on the surface tar The tar is thus heaped up most pronouncedly just before street intersections on hills on the right side of the road going downwards, whereas on the other side, that is, the right side going up, the surface remains in good condition considerably longer but gradually develops corrugations of a regular character due to the even action of the steady pull of ascending wheels on the surface.

My observations tend to show that the worst damage is done to a road by the braking action of motor vehicles descending hills at considerable speed This applies to *all kinds of surface*, and is independent of any method of construction or repair

As far as tarred roads are concerned, a single rut at right angles to the direction of heavy traffic will soon distort



Professor Pickering's fork telescope mounting. For observers in the temperate zone, the diagram will be held diagonally

the whole surface, beginning at the rut and forming regular waves on a horizontal road On a hill, the two sides will show distinctly different types of surface distortion as described above Road scrapers have nothing to do with it, though they may be criticized as road building implements and found wanting.

G Brodsky,
Worcester, Massachusetts.

Telescope

Down in the island of Jamaica, forty miles inland on an elevated plateau, Prof William A. Pickering lives the year around in a home adjacent to his astronomical observatory, near Mandeville. From this vantage point only a few degrees from the equator he can see far more detail of Mars and the moon than most of us whose higher latitudes require the light from the planets to pass through many times more of the earth's disturbing atmosphere. Prof Pickering has always been interested in the amateur astronomer, and now he contributes an interesting suggestion for a style of telescope mounting that conduces to comfort during observation.

Editor, Scientific American·

So many amateur astronomers are now constructing reflecting telescopes of the Newtonian type, that it is possible that some of them may be interested in a form of fork mounting that has recently occurred to me.

A prominent advantage of the fork is that we never have to reverse the telescope in the midst of an observation, when the object is crossing the meridian, as is necessary with the ordinary form of mounting. The very great inconvenience of the movable high seat, and the nuisance of the rotating tube, in the larger sizes of Newtonian telescope as ordinarily constructed, should certainly be avoided if possible The former is particularly inconvenient if we wish to observe objects south of the zenith and near the meridian

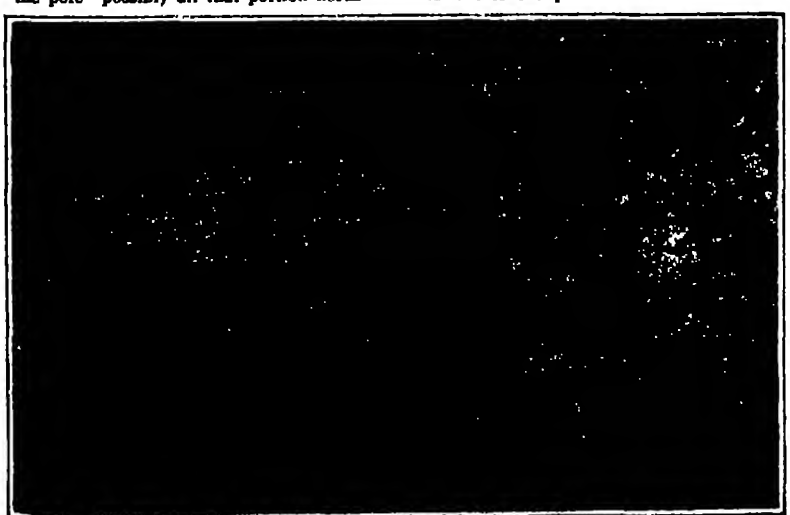
In order to avoid these objections, I sacrifice at once that portion of the heavens in the immediate vicinity of the pole—possibly all that portion north of declination + 60 degrees This is about one-fifteenth of the whole heavens. This would cut me off from observing two out of the five well known stars in Cassiopeia The northern pointer in Ursa major would also be eliminated The constellations of Camelopardus, Ursa minor, a portion of Draco, and Cepheus would also be beyond my reach. But none of these are of any consequence, and I should leave them to *other observers. I should then construct* my mounting as indicated schematically in the accompanying figure

The length of the telescope could be anything desired—as long as a refractor if convenient. I have drawn the tube 12 inches in diameter The breadth of the casting of the fork at the end of the polar axle, C, is assumed to be six inches. It might perhaps be narrower The distance from this point to the center of the flat, F, is 18 inches. The mirror is not shown, as it would be beyond the figure to the right The light from it strikes the flat, and is reflected through the short declination axle to the eye-piece, E.

Either end of this axle can be used, and in order to do this the flat is supported by a tube A, A, A, A, which rotates within the telescope tube. A hole in these two tubes transmits the light from F There is no need in this case of rotating the large mirror One of the finders is shown at B. There should be another similar one on the other side of the fork. The counterpoise ring is shown at D, D

The observer's height will not change greatly during the observation Otherwise he will not move until the object crosses the meridian, when he will shift to the other side of the pier, carrying the eye piece with him, or using a duplicate one. For northern objects whose altitude does not exceed 30 degrees he will have to look upwards at an angle of 60 degrees or a little more, but this is not unusual to those accustomed to the use of a refractor When the object crosses the meridian he will be looking horizontally

For a long focused reflector it is possible that a movable seat could be attached to the pier With such a short



A reproduction of an early form of envelope with the postage prepaid

fork the observer would find that objects crossing the meridian at an appreciable distance north of the zenith would be cut off for a short time by the pier itself This could be partially remedied either by making the tines of the fork longer, or by using an iron pier curved to the north

An incidental advantage of the fork mounting is that we can readily make the tube appreciably larger than the mirror This, it is believed, would avoid some of the trouble caused by air currents circulating within the tube With the ordinary form of mounting such an increase of size would add considerably to the expense It is believed that the fork mounting could be manufactured more cheaply than the usual form

W A Pickering,
Mandeville, B. W I

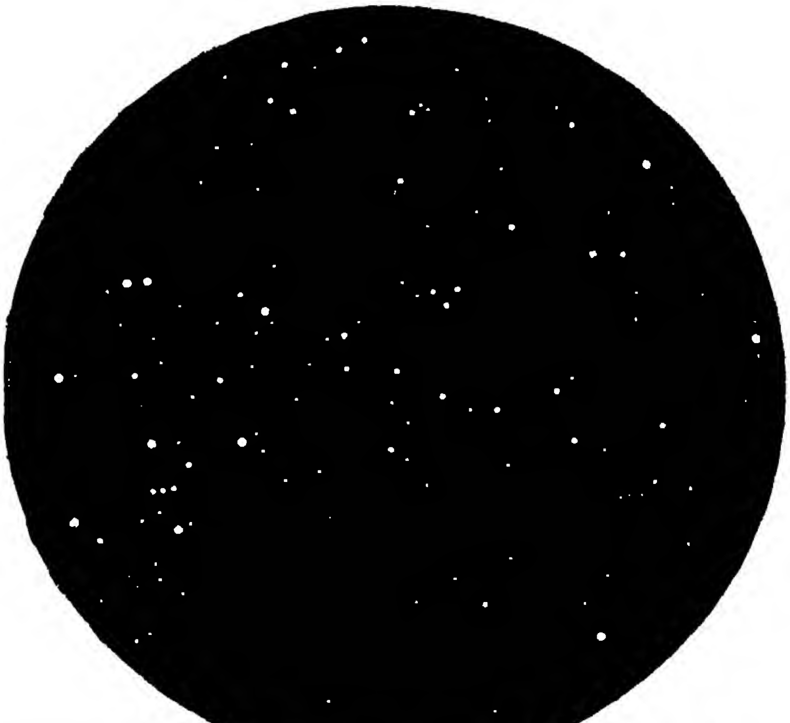
The First Postage Stamp

One of our correspondents who is an enthusiastic stamp collector sent us a photograph, which we reproduce on page 389, of the alleged first postage stamp which is interesting, not as a postage stamp at all but because it is a whole envelope. He writes as follows:

"It is a mistake to assume that this envelope was really the first attempt at using an indicator of prepayment. As a matter of fact a postpaid envelope was in use in Paris in 1693 and stamped postal letter paper was issued by the Sardinian States, but it remained for Great Britain to inaugurate cheap and universal postage within a state In 1839, prizes were offered for the best suggestions as to the use of stamps. The first prize was two hundreds pounds, the second prize was one hundred pounds. Two thousand seven hundred replies were received but no improvement was advanced over Rowland Hill's idea of a postage stamp. Both the envelopes and stamps were tried out by the public and the stamps won out. Each sheet of stamps carried this notice "Place the label *above* the address and toward the right hand side of the letter In wetting the back be careful not to remove the cement" The so-called "Mulready Envelope" soon passed out of existence and into the collector's album but the idea survives in stamped envelopes.

The Heavens in November

By Professor Henry Norris Russell, Ph.D.



At 11 o'clock: Nov 7
At 10½ o'clock Nov 14
At 10 o'clock: Nov 22.
At 9½ o'clock: November 30
At 9 o'clock: Dec. 7
At 8½ o'clock: Dec. 15.
At 8 o'clock Dec. 22.

NIGHT SKY: NOVEMBER AND DECEMBER

The Heavens

FROM the star map this month, it will be found that, at the hours mentioned below it, Perseus, Andromeda and Aries are almost overhead Mars, which is in the last named constellation, is high in the southeast and recognizable at once by its great bright ness and ruddy color

The southern sky is dull but the east is splendid, showing Auriga, Taurus, Gemini, Orion and the two dog-stars low on the horizon The two Bears and the Dragon are low in the north and Cassiopeia is high Cygnus and Lyra are sinking in the north west and Pegasus is high in the west. The brightest object in the southwest is the planet Jupiter now well toward setting.

The Planets

Mercury is an evening star before the 25th and a morning star afterward He would be fairly well visible in the early part of the month if he were not so far south, but, as it is, he sets at 5 50 P M —although 23 degrees from the sun—and will be hard to see Venus is still a morning star when the month begins, but comes into conjunction with the sun on the farther side on the 21st. At this time she comes very near to going behind the sun's disk, in fact, within six minutes of the northern limb, but unfortunately, she is invisible

Mars is in opposition as has already been stated, and is visible all night. Jupiter is in the eastern quadrature on the 11th and comes as an evening star, remaining in sight until 11 P M Saturn is in conjunction with the sun on the 21st and is invisible but it is worthy of note that on this date, he is also in conjunction with Venus, both planets and the sun being included in a circle about two degrees in diameter Uranus is in Pisces and comes to the meridian about 8 P.M

The moon is new at 10 A M on the 5th, in her first quarter at 6 P M on the 12th, full at 11 A.M on the 19th, and in her last quarter at 2 A M. on the 27th. She is nearest the earth on the 16th and farthest away on the 28th During the month, she is in conjunction with Venus on the 4th, Saturn on the 6th, Mercury on the 7th, Jupiter on the 12th, Uranus on the 15th, Mars on the 17th and Neptune on the 26th.

Learning to Use Our Wings

Aircraft are being put to use in peace as well as in war. This department will keep our readers informed of the latest facts about airships and airplanes

Conducted by Alexander Klemin

In charge, Daniel Guggenheim School of Aeronautics, New York University

An Air Sleeper

THE German publication *Flugsport* describes the Albatros *L 73*, equipped with two 240 horsepower engines, in which the problem of providing an air sleeper has been seriously attempted. The passenger cabin is provided with every comfort. The cabin is 5¾ feet in height, five feet in width and 18 feet in length. There are eight seats placed along the walls of the cabin. In between the seats is a gangway which leads into the pilot's compartment at the forward end of the fuselage. The seats are comfortably upholstered and provided with adjustable backs. A few adjustments and the four seats on either side are converted into two bunks, so that four men in all can sleep comfortably in the cabin.

Under each seat there is space for passengers' hand baggage with additional baggage accommodation in the overhead nets. Overhead lighting, large windows of triplex glass, warm air heated by the exhaust, and a convenient washroom in a separate part of the fuselage complete the arrangements for passenger comfort.

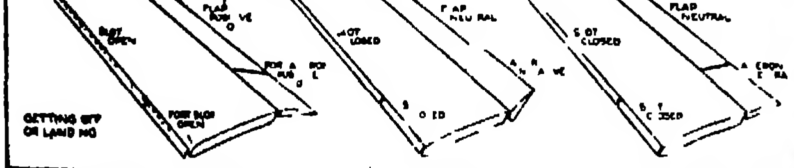
It is interesting to see how the once cramped cockpit, open to every blast, is evolving into a regular Pullman sleeper. The only drawback to the air sleeper is the uneconomical prospect of carrying only four passengers with a horsepower of 480. Perhaps the airplane cabin will grow slightly higher and the double decker familiar to every Pullman traveler will finally make its appearance.

Slotted Wings and Flaps

WINGS with slots at the leading edge, and slotted rear flaps are now being used in at least four machines in England and Germany. It is surprising that their use is not spreading even faster. In the trials of the Handley Page *Hendon*, a torpedo carrying plane, equipped with these devices, some surprisingly slow speed landings and glides on a steep path with the fuselage almost horizontal were recently made. The diagram reproduced from *Flight* illustrates the very latest method of employing the slot and flap for increasing lift and for improving the lateral control.

On the left of this diagram is shown the disposition of the device for getting off and landing. The front slot is open, the rear slotted flap is depressed. The lift coefficient of the wing is thereby increased between 75 and 100 percent over its normal maximum value. The landing speed can be reduced correspondingly, adding appreciably to the safety of the craft. On the right of the diagram the end and center slots are closed and the end and center flaps are held neutral; this is the best condition for fast normal flight. In the center diagram the middle slot and flap are closed and neutral respectively, and the end slots and flaps used in a manner to make them most effective for control in normal flight.

The particular advantage of this device, besides increasing the lift and the power of the ailerons, lies in the fact that the ailerons continue to be effective when the wing is at a large angle of incidence beyond the burble or stalling point. Conventional ailerons beyond the stall become ineffective and produce a dangerous tendency to turn the machine in a direction which does not correspond with the desired bank. We have dealt with this topic at length in previous issues of the Scientific American. The interest of this latest information lies in the special disposition of slot and flap now adopted. Evidently British designers have decided that the aileron control must be distinct from the lift producing center slot and flap even at the expense of greater complexity.



There are many advantages in the use of slotted wings and flaps such as are diagrammatically shown above and described in the text

Brakes on Airplanes

BRAKING the wheels of an airplane shortens the landing run but tends to nose the plane over. Placing the center of gravity far behind the wheel axle eliminates nosing-over, but makes it difficult to raise the tail off the ground in making a getaway. The combination of front wheel brakes and a third small wheel at the tail seems to have eliminated all difficulties. In the recent Detroit Reliability Tour many of the machines were equipped with brakes and came to rest in 100 feet instead of the 400 or 500 feet customary hitherto. With brakes it is no longer necessary to use ground tackle or to have men hanging on to the tips of the wings, the pilot puts his brakes on, opens his engine full and starts off with the ease of an automobile driver. If the brakes on either side are independently controlled it is possible to steer in taxying on the ground even when the air rudder is scarcely effective. Many different types of airplane brakes are now available. In the Douglas 1 2 of the type used in the round the world flight two large metal disks are used, one bolted to the outside of the wheel and the other mounted on the outer end of the axle in such a manner that it bears against the wheel disk when the brake pedal is depressed. The brake cams are actuated by flexible cables connected to the brake pedal. These cables pass through the hollow struts of the landing gear.

European Air Transport

AIR Vice Marshal Sir Sefton Brancker has been for several years Director of Civil Aviation in the British Air Ministry. His lecture on Air Transport before the London Junior Institution of Engineers may therefore be regarded as an authoritative pronouncement.

No subsidies to air lines have ever been granted in the United States nor are they likely to be granted. The Air Commerce Act of 1926, which provides for the appointment of an Assistant Secretary in the Department of Commerce, will allow this Department to give navigational aids to air lines in the form of lighted airways, radio

International Newsreel

The submarine plane stowed away in its tube, into which the various parts fit neatly. The tube is fixed to the top of the submarine deck

direction beacons, and by the transmission of weather reports. This indirect form of aid is accepted by almost all authorities as far more advisable than the European method of actually subsidizing air line operators in cash.

As a result of subsidies, the British, French, German and other services make no extraordinary efforts to run at anything but a loss and Sir Sefton points out that only one air line in the world is paying its way, namely, the Scadta, up the Magdalena River to Bogota, in Colombia The subsidies paid or voted for in 1925 in England, France and Germany respectively were 137,000 pounds, 57,210,000 francs and 6,700,000 gold marks, and it is evident that these cannot be continued indefinitely

The Air Marshal states that the present total cost of carriage by air is about 5 shillings or say $1.25 per ton-mile at 90 miles per hour This is a figure of about the same order of magnitude as that of the closest American estimates. In his opinion, such a charge is high but not too high for passenger traffic, is low enough to attract first class mail matter, but is too high to attract any great volume of freight Undoubtedly this would apply in America also

Airplanes are frequently regarded as fragile craft of short life On the Imperial Airway from London to the Continent, machines show an average of 1,000 flying hours per year, and are useful for several years.

Airplanes were once regarded as a very bad insurance risk, with premiums running as high or higher than 20 percent. Now they have fallen to 7½ percent for three-engine-ships, with only slightly higher rates for the single-engined types.

The ultimate success of air traffic depends on public confidence. Statistics given by Sir Sefton are most encouraging. Taking the period from May 1919 to December 1925, the mileage flown in recognized British transport service was 4,431,000. There were four fatal accidents in which 13 passengers were killed and five injured. There were no fatal accidents at all in 1925. With the use of multi-engined planes, various devices to reduce the stalling speed, and with better methods of navigation, the danger of accident is beginning to be regarded by British authorities as almost negligible.

A Submarine Plane

A SUBMARINE scouting for an enemy has neither great speed, nor a long range of vision, whether submerged and sighting through a periscope or floating on the surface but without the aid of mast or conning tower Accordingly, the United States Navy has for several years sought to develop a submarine plane and to devise methods for stowing it on board.

In the design of the plane, the problem was to produce a craft small enough to be packed in a tube not more than five feet in diameter, yet thoroughly airworthy Cooperation between the Navy Bureau of Aeronautics and the Glenn L. Martin Company has resulted in the production of the small seaplane shown in the first of our photographs. The seaplane has a cockpit just big enough to shelter a pilot who is not of excessive proportions. Its engine is a light

International Newsreel

The small submarine plane assembled on the deck of the S-1

three-cylinder Wright air-cooled type. The spread of the wings is approximately 20 feet, and the overall length is proportionately small. To facilitate assembly and disassembly, the plane, although it is a biplane (a monoplane would have a larger span and would therefore be less suitable), has no bracing wires requiring careful adjustment, the wing truss consists entirely of struts acting as either tension or compression members. The truss is further simplified by the fact that the struts going from the outer point of the wings to the pontoons serve also to brace these pontoons. No guns are carried, the gasoline supply is sufficient only for two hours' flight, and by cutting out all non-essentials, the weight is kept a trifle under 1000 pounds when fully loaded. The loading per square foot of wing area is somewhat high, and this, with the low gross weight, keeps the wing area at a minimum. The little craft, though provided with only 60 horsepower, is capable of at least 80 miles an hour.

As a result of this careful design, the plane can be readily packed in the comparatively small tube shown. The fuselage occupies the center of this tube with the engine still mounted at its front end. The wings, in four parts, are slid into position at the periphery of the tube, and the pontoons are neatly wedged in between.

A few minutes suffice for disassembly, nine minutes for complete assembly. To make a get-away the deck of the submarine is kept almost flush with the level of the sea. The plane moves under its own power on specially prepared ways and leaves the water just as any hydroplane. Hoisting the small plane on board again is not especially difficult since the deck may be kept as low as desired whereas on a battleship, hoisting the plane aboard is quite a delicate operation.

An Airship Control Cabin

COMMANDER CHARLES E. ROSENDAHL was the senior surviving officer of the *Shenandoah* and is now commander of the *Los Angeles*. He is shown in the control cabin of the giant airship. Just a glance at the photograph is sufficient to indicate the complexity of airship piloting. In this work there are many more things to think of than in handling an airplane. The amount of water ballast must be watched if longitudinal balance is to be maintained, and a special chart for this purpose appears in the control cabin.

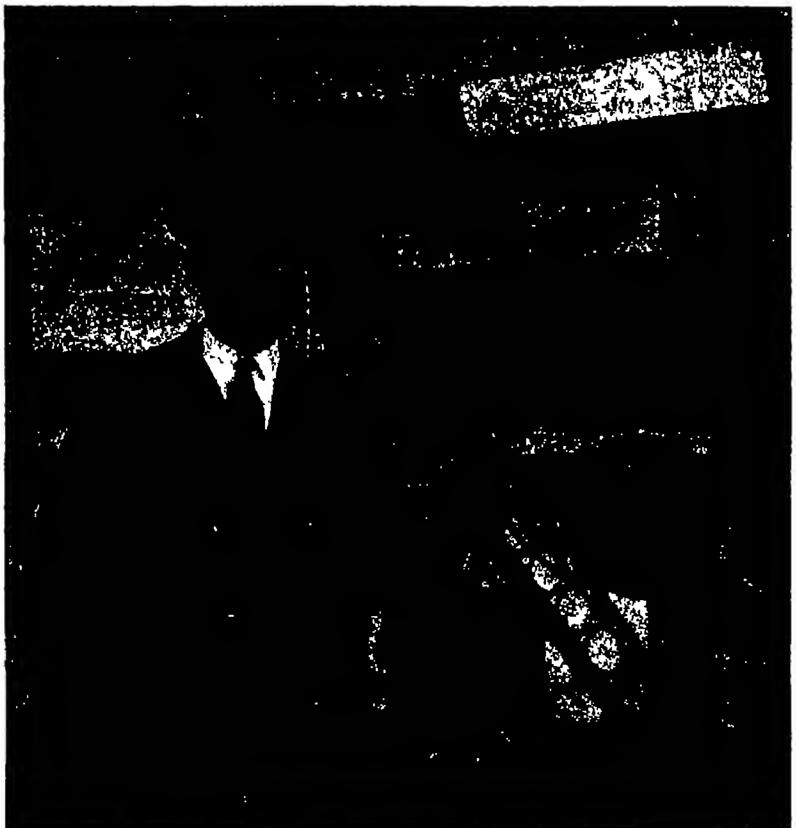
As the *Los Angeles* burns up fuel, it becomes lighter, shoots up high into the air and must lose valuable helium to descend unless the water recovered from the engine exhaust gases is sufficient to compensate for the loss of fuel weight. Hence the lines labelled "Fuel" and "Water Recovered" figure prominently on the board. Each compartment of the airship needs watching as regards gas pressure and content, hence the gas control connections in the upper right corner of the picture. All this, in addition to the engine controls, actual steering, study of weather conditions, et cetera, make the control cabin of an airship a very busy place.

Maintenance of Airplanes and Engines

THE scientific aspects of aeronautics have been given intensive study in many laboratories both in the United States and in Europe. But, little systematic attention has been given to problems of maintenance and depreciation. However, reading Lieutenant E. W. Dichman's paper in the *A. S. M. E. Journal* (American Society of Mechanical Engineers) is a revelation as to the work done by the Army Air Service in this direction.

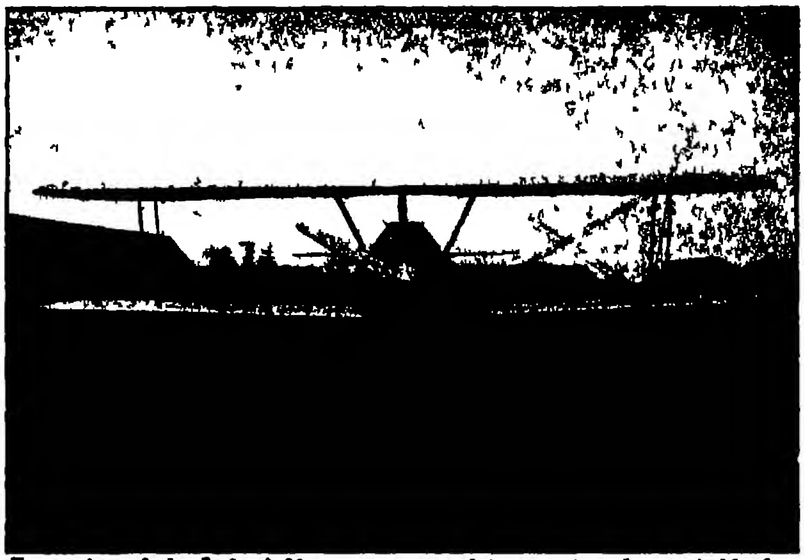
In military flying a few forced landings due to engine trouble may be excusable but in commercial operation, engines *must not fail*. There are now far more reliable engines in use than the Liberty motor, but from consideration of expense the Liberty as it is surplus war material will be used for many years to come. How much service is then to be expected from the Liberty? According to air service practice 150 hours. Then there must be a complete overhaul, which in man hours must be given 175 units. This must include a complete overhaul tear down, cleaning of parts, inspection, grinding of valves, assembly and timing. With such care the life of the Liberty may be as much as 500 hours.

Airplanes may run as long as 250 hours between overhaul (and this means some 200 000 or more miles of flight). With a periodic overhaul of 200 man hour units,



Wide World

Commander Charles E. Rosendahl in the control cabin of the *Los Angeles*. Note the charts on the wall, and the control cords above them



Front view of the Ireland *Meteor*, a neat and inexpensive plane suitable for general aerial service and private ownership

according to Lieutenant Dichman the life of an airplane may actually be 2000 hours before salvage becomes imperative. The overhaul consists of removing the fabric from wings, fuselage and tail surfaces, inspecting all fittings, spars and the internal structure generally, and of reassembly with the utmost care in lining up.

Even the life of the present type of plane and engine becomes satisfactory from a commercial point of view if maintenance and inspection are given due care.

A Useful Plane

WHILE public attention is largely concentrated on the large airliners of the type built by the Fokker and Ford companies, the plane suitable for individual ownership is selling in fairly large quantities. One midwestern company reports a production of a plane a day. The Ireland *Meteor* built at Garden City is an excellent example of the small inexpensive plane suitable for general aerial service work and for the private owner. Our two photographs show its many desirable characteristics. A thin bladed Curtiss Reed duralumin propeller is employed which has both a greater efficiency and a greater durability than the wooden propeller. The engine is the well tried OX-5, an eight cylinder water cooled type, of comparatively low fuel consumption, with which the plane manages to carry a pilot and three passengers at a maximum speed of well over 90 miles an hour. The spinner and cowling give a very streamline appearance to the front of the fuselage. The pilot and front passenger have particularly good vision. The landing gear is of the no-axle type, reducing the effect of obstructions on landing. Rubber compression rings are used instead of shock absorber cord, thus obviating much tiresome winding and replacement of cords. The tail skid is steered from the rudder pedals, giving complete directional control of the plane while taxying on the ground. An interesting detail is the control stick which is located between the pilot's feet and curves back over his knees so that there is no need for spreading them apart to operate the ailerons.

Flying at Night

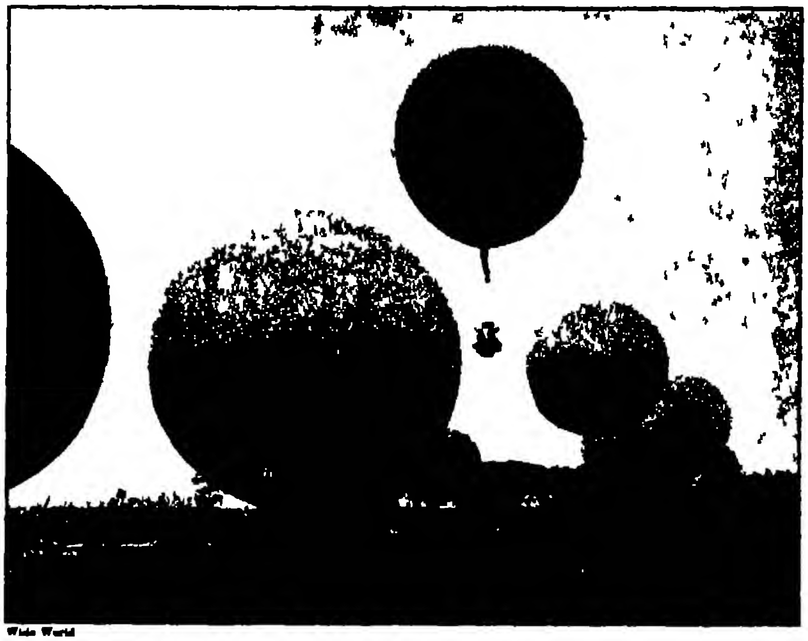
WESLEY L. SMITH is one of the most skillful and experienced pilots flying for the Air Mail Service. In a recent paper read before the Society of Automotive Engineers he ended with this remark: "If any of you are slightly bored with life and crave a little excitement, just hop into a plane some dark and stormy night and try to fly to Cleveland from New York." His paper was conclusive evidence both of the difficulties of night flying and of the care and ingenuity which has made it possible.

The country from New York to Bellefonte, Pennsylvania, is a series of valleys and mountain ranges; from Bellefonte to Cleveland, it rises at once to a plateau with narrow river gorges and low mountain ridges sloping down gradually to Cleveland. On the whole it is difficult territory and the weather is often uncertain and dangerous. If night flying is possible between New York and Cleveland it will be possible almost anywhere in the United States.

Emergency fields are placed at 17 mile intervals. The distance between the giant beacons of 2,000,000 candle power is eight

(*Continued on page 396*)

Side view of the Ireland *Meteor*. With an OX-5 engine, this little plane can carry a pilot and three passengers at 90 miles per hour



Wide World

In the race for the Gordon Bennett Trophy, held at Brussels, Belgium, American balloons took first and second places. Ward T. Van Orman and Walter W. Horgan won the trophy after covering 528 miles in the *Goodyear III*. The United States Army balloon, *S-16* won second place. The start of the race, with the *S-16* in the center on the ground, is shown above

miles on an average. Each terminal and emergency field is bounded by lights about 250 feet apart. At the terminal fields all obstacles are surmounted by red lights and the best approaches indicated by green boundary markers. The lights of cities and towns, large factories, blast furnaces and the like are great aids to a pilot who knows the route. But thick weather may obscure both the beacons and the natural lights to a great extent.

Even in fairly clear weather emergency night landings are hazardous. Great care has been expended on lighting the plane itself. The special night equipment comprises three navigation lights, one on each wing tip and one on the tail to enable pilots to see other ships *en route*; two large headlights on the order of automobile headlights but much more powerful are used in emergency fields which have no flood lights; and two magnesium parachute flares are carried which at an altitude of 2000 feet will light a square mile of territory brilliantly.

But even all these lighting aids are not sufficient; instruments must be carried which will enable the pilot to fly straight although nothing outside of the ship be visible.

There is first the compass which on board aircraft has reached a high degree of refinement. But the compass is a poor guide in storms because when the ship oscillates in rough weather the compass needle comes under the influence of the vertical component of the earth's magnetic field and swings about erratically. Therefore the compass is supplemented by a turn indicator, which is based on the ability of an air driven gyroscope to keep a direction always parallel to its original one. Pilots who have to rely on their senses alone in fog lose their perception not only of direction but also of balance. Hence a bank indicator or lateral inclinometer is carried which consists of a steel ball in a slightly larger curved glass tube filled with alcohol to dampen mechanical vibrations.

Flying by instruments alone is an intense physical and mental strain on the pilot. The plane itself should be stable fore and aft, laterally and directionally. It should be one that is capable of being flown "hands off," whether flying level, climbing or descending in fairly rough weather. Modern mail planes are beginning to approximate these requirements. Further the craft must be extremely maneuverable for getting in and out of poor emergency fields; it must have a slow landing speed because emergency fields are small and it must have a rapid climb to clear obstacles on a take-off or clouds whose moisture may freeze on the ship. Besides 1000 pounds of mail, and fuel enough for a non-stop flight against a head wind of 30 miles an hour, there must be at least an hour's emergency fuel supply on board to guard against the possibility of losing the way in bad weather.

Reports of the much maligned Weather Bureau are indispensable. The weather stations give the pilot the type of weather, ceiling, visibility, wind direction, temperature and barometric pressure. The ceiling, as it is aptly called, is the height of the clouds above the ground measured by projecting a spot light at an angle of 45 degrees and by pacing the distance from the light to the point directly under where the beam hits the clouds. From the weather maps a skilled navigator can nearly always tell what awaits him ahead. Now that radio communication between plane and ground is available the utility of these weather reports is further enhanced.

Thunderstorms are very hard on the flier. When the temperature ranges around the freezing point, moisture in the clouds will freeze onto the plane, first upon the wires, increasing them with the ice coating to three times normal size, then upon the struts and fabric, loading the plane, increasing its resistance to the air stream and finally bringing it down at landing speeds 20 to 30 miles higher than normal. But the very worst enemy is fog. The visibility of the most powerful beacons disappears. It is then that reliable instruments and courage are really needed.

The Air Mail Service has done a wonderful piece of work in making night flying possible. But it is quite evident that there remains for the Department of Commerce, now taking over the provision of navigational aids to flying, a really difficult task and one which will involve the improvement of airway lighting, the improvement of weather reporting, the use of radio direction beacons and the provision of many other devices which will tax the energies of its engineers.

An Engine Heater

AIRPLANES in ordinary winter service are often placed in unheated hangars. Under such conditions it is either necessary to drain the water from the engine, or to keep the engine warm enough to prevent the water from freezing. The *N. A. A. Review* describes a simple device which overcomes this difficulty. This is the Mayall heater, consisting of a short brass tube about eight inches long, surrounded by electric heating elements. The brass tube is inserted in the water line near the engine, thus setting up a circulation of warm water in the system. For 60 cents, 16 hours of heating can be secured, and all freezing difficulties avoided.

Commercial Property News

A Department of Facts and Notes of Interest to Patentees and Owners of Trademark Rights

Conducted by Milton Wright

Don'ts for Inventors

IF there is one thing the inventor will not tolerate, it is to have anyone say, "It can't be done." More power to the inventor for that attitude! It is the attitude that has overcome all the obstacles in the way of progress, it is the attitude necessary for success in invention as well as in any other field of endeavor

However, there is a limit to the things an inventor should try to do—perpetual motion for example. Scientists generally agree that perpetual motion is impossible. The Patent Office agrees with the scientists and imposes extra restrictions upon the inventor who claims to have solved the problem.

Nevertheless, perpetual motion does seem to have a fascination for inventors. Only last week a very earnest man tried to induce us to apply for a patent for him on a device which would run without stopping There have been hundreds of such efforts in our offices alone in the eighty years that we have been aiding inventors. It is not likely that you can solve the problem of perpetual motion At any rate, your time and ability can be spent to far better advantage in seeking to answer one of the many other needs of modern civilization *Don't bother with perpetual motion*

"The Perfection of Imitation"

THE invention which the court has called "the perfection of imitation," the embossing process of the Simplex Sampling Association, whereby illustrations in advertising look like an actual piece of cloth pinned to the paper, has won a substantial victory in an infringement suit against the John C. Powers Company

The patent relates to cards for displaying textile samples. Instead of the actual textile being used, a raised panel is formed by an embossing process and the texture and fabric is reproduced in color

"The new product is the production of illusion," says Judge Hand, quoting a previous decision, "i e., making the eye believe that actual pieces of cloth are in view"

The defendant's device sought to accomplish the same result by "making a panel raised above the base to a distance substantially less than the thickness of the fabric simulated, said panel having one edge inclined from the plane of the panel to the plane of the base." Nevertheless, the court holds, "The differences relied upon to secure immunity seem technical and trivial. A preliminary injunction is granted upon filing a bond."

Names from the Orient

THE novel argument that trademarks deceive the public if they suggest the same scenes, traditions or historical events that other marks do, was made in vain by the Egyptian Lacquer Manufacturing Company in its recent patent opposition to registry of the word "Pharaoh" as a trademark for lacquers. The opposer uses the names Egyptian, Sphynx, Pyramids, Obelisk, Nile, Cairo, the representation of the Sphinx and the representation of an Egyptian scene as trademarks for the same goods.

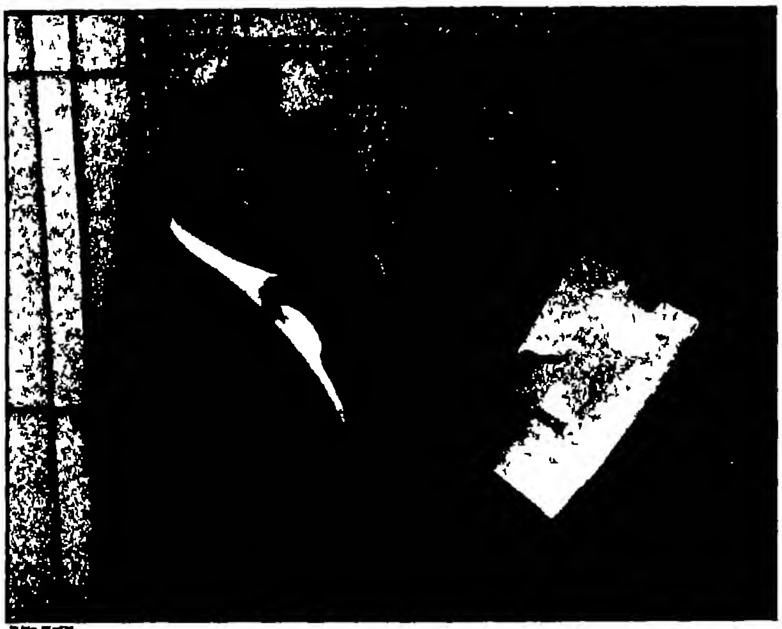
"The identity of resemblance of trademarks may be ascertained only by comparison of the marks with each other," Assistant Commissioner Moore holds. "If the one mark creates in the mind a picture corresponding to the essential characteristics of the other, or if both suggest the same object of thought, they may be said to bear such resemblance to each other as to confuse the mind of the public, but not otherwise

"The name 'Pharaoh' does not in any way suggest any of the opposer's marks On the contrary, the name creates in the mind thoughts corresponding to the historical events which occurred in Egypt during the reign of its ancient monarchs, including the miracles and tragedies related in the sacred writings.

"If the opposer's contentions were tenable, it would be possible by a wise selection of a term universal in its signification to practically monopolize all trademarks for a particular class of goods"

Americans Lease German Patent

AMERICAN patent rights covering a recently invented German process for automatically producing bas-reliefs, sculptures, medallions and like articles have been sold to an American corporation, according to a report to the Department of Commerce



Wide World

With the "camera gun" invented by Adelbert Szalardi you get your man's picture whether you hit or miss. A camera attachment works with the pressure of the trigger finger. Magnesium in the ammunition charge permits night photography. The film chamber may be locked with a key retained by the police

The process requires the use of a special stereoscopic camera and a "stereocomperator," which transfers the picture taken by the stereoscopic camera to the block of raw material upon which the design is to be sculptured.

The process, which is said to reproduce natural colors, is expected to be used in connection with advertising and the production of novelties.

"O-G-Goody"—"Eskimo Pie"

THE Eskimo Pie Corporation raised a novel question recently in opposing the registration of "O-G-Goody" as a trademark for a chocolate-covered ice cream confection The basis of the opposition was that the opposer owns a patent for a confection to which the trademark "Eskimo Pie" has been applied and that the acts of the O-G Goody Company in selling its confection is an infringement of that patent

The Patent Office, however, dismissed the opposition, declaring it has no jurisdiction, where the marks of the two parties are wholly dissimilar, to pass upon the infringement of a patent or upon questions of unfair competition generally.

Brown Wins His Patent Suit

ALBERT C BROWN of Chicago, inventor of an adjustable faucet famous throughout the plumbing trades, has won his suit for infringement against the Empire Brass Manufacturing Company Brown's patent is for an adjustable faucet attachment such as is extensively used in kitchen sinks and laundry and bath tubs It is designed to connect with hot and cold water supply pipes and has a mixing chamber and a single spigot faucet All the elements of his combination are old except the adjustable connections between the faucet ports and the supply pipes

The defendant relied upon the usual defenses of invalidity and non infringement Judge Westenhaver writes the opinion for the United States District Court for the Northern District of Ohio He reviews some of the prior art cited by the defendant but finds they are not in the particular branch of the industry in which Brown made his invention The fact that the plumbing trade has acquiesced over a long period in its validity he holds to be a strong point in Brown's favor

"Defendant's purpose could be none other than to achieve adjustability" he says "and it has done this by using an offset swivel connection instead of one curved or bent It permits easy application of the combination faucets to hot and cold water supply pipes in the same manner and for the same purpose as taught and claimed by Brown when the off-center variation does not exceed one half to five-eighths of an inch To this extent at least it is an equivalent of Brown's adjustable link or pipe"

Inventions in Literature

HOW many inventors are there who realize that a patent may not be obtained on a device if the device has been fully described in a printed work, even though the writer never made one of the articles? That a published description may upset the validity of a patent was illustrated, in the case of John I Brodie against the United States early this year, by the Court of Claims. Brodie was suing the government for royalties on hats made according to his patented design.

In declaring his patent invalid the court relied in part upon quotations from the following publications

Homer's Iliad
Dictionnaire du Mobilier Francais
La Nature
Scientific American

"It is rather startling" the court declares, "in connection with the consideration of this case to have attention called to an opinion by Judge Westenhaver of the Northern District of Ohio in which considering the validity of a patent on an automobile bumper he, by way of illustration, said shields fenders and devices for purposes of protection are of immemorial antiquity In the World War, when it was realized that some protection against shrapnel fire would be serviceable, the need was at once answered by the development of the steel helmet In a commercial sense the steel helmet was new but in a patentable sense it was not novel nor an invention"

Congratulations, Mr. Wrigley

GERMANS like American chewing gum so much that they have resorted to court action to permit greater importation of it By a final decision of the Court of Appeals at Munich, chewing gum has been so reclassified as to reduce import duties on it from 300 to 100 marks per 100 kilograms This reduction follows continued representations by importing houses in Germany assisted by consuls and the American commercial attache

Our own Department of Commerce reports that chewing gum first offered for sale in China 12 years ago and its purchase limited largely to the American population, has increased as an export item from a few cases to approximately 1 000 to 1,200 cases a year It is estimated fully 95 percent of the gum now sold in China is to the native Chinese

Of the People, by the People, for the People

THE Lincoln Motor Company has lost two cases against other companies using the trademark "Lincoln" In refusing to cancel the registration of the name as a trademark for the shock absorbers of the Lincoln Products Company, Assistant Commissioner Moore declares

"The Lincoln Motor Company has used its trademark only in connection with motor cars. The Lincoln Products Company uses the name Lincoln' and the portrait of Lincoln as trademarks for shock absorbers A structure considered as a whole, and the parts of which it is composed are different things, hence, have not the same descriptive properties"

In permitting the Lincoln Manufacturing Company to register Lincoln' with a distinctive design as a trademark for automobile brakes and timers, he says

"The applicant calls attention to many registered trademarks and to many names of companies and corporations in which the word Lincoln' appears. Judicial notice may be taken of this fact, and also of the fact that Lincoln is commonly employed as the name of individuals and also as a geographical name"

The Old Home Savings Bank

NOT only may the Bankers Utilities Company not collect anything from the Pacific National Bank but the United States District Court for the Northern District of California holds that the patent for the mechanical book-shaped bank for home savings (invented by Butler Greer) upon which suit was brought, is invalid, because all of its

elements are old The utilities company, licensee of the patent, had sued for infringement and for an accounting

"The main question in this case" says the court "is whether or not the book form of savings bank as shown and described and claimed in these letters patent was anticipated by the prior art Among the patents introduced in evidence by defendant to show the various elements comprising the Greer patent construction, are the Fisher patent, the Von Eigen patent, and the Farrington patent.

"It should be noted that the contents of the file wrapper of the Greer patent fail to mention the above named patents, a fact which, I think, is persuasive that various elements of the Greer patent as claimed are old and anticipated All of its elements are invalid, for the reason that all of them were old Taken together, they also are invalid as being merely an assemblage of old elements which accomplished no new result

"Let the decree be for the defendant."

No Trademarks for Service

THAT a company which sells service rather than commodities cannot register a trademark for articles it handles is made clear by Assistant Commissioner Moore in denying the application of Gregg and Son, of Indianapolis, to register a trademark for repaired, cleaned, renovated and dyed fabrics and furs.

"A trademark as such can have no existence apart from an article of commerce, and unless it is indicative of origin or ownership of the article," he declares. "The applicant admittedly is not a trader, and the articles to which it applies its private mark are not articles of commerce The mark does not indicate origin or ownership."

"Ford" Mark Not Exclusive

THE Ford Motor Company has lost two actions recently to prevent others from using the name "Ford" In an action in the United States Court in New York to restrain the independent firm of Kelly and Stein from using "Expert Ford Service," Judge Thatcher rules.

"The words in their ordinary significance do not convey a false impression and it does not seem to me proper to enjoin their use until the secondary meaning sought to be attributed to them by the plaintiff is more clearly established."

In a cancellation action in the Patent Office against John A McAdoo who registered the trademark "Ford" for cigars, Assistant Commissioner Moore holds.

"It must be remembered that the word 'Ford' is not necessarily confined to the corporate name of the petitioner It is a common word of our language used not only as a name for many persons, but also as a common noun and as a verb."

Day Gun Pad Patent Void

IN a suit brought by W R Jorgenson against F D Hawkins in the Circuit Court of Appeals of the Eighth District for injunction and damages for infringement, the court holds that J S. Day's patent for a recoil pad for gun stocks is invalid The court rules that the fastening of a hard rubber base plate to the gunstock and a relatively soft rubber pad to the hard rubber plate does not involve invention

"Although the exact form of air cushion shown in the Day patent is not disclosed in the prior art," Judge Booth writes, "yet there was disclosure of such character that the change made by Day cannot in our opinion be classed as invention Our conclusion is that the Day patent is void for lack of patentable novelty"

Victory for De Forest

THE decision of Judge Thompson in the Federal District Court, in holding Lee De Forest to be the first and original inventor of the feed-back circuit and the oscillating audion will have a far reaching effect in the radio industry Twelve of the claims of the celebrated Patent No. 1,113,149, issued to Edwin H. Armstrong, are held to be invalid.

Due to lengthy litigation, the De Forest patent did not issue until September 2, 1924. It will not expire, therefore, until 1941. In the meantime, De Forest has a monopoly over any forms of radio circuit which his patent covers. Also, he may now hold manufacturers to an accounting of profits accruing from any infringements since September, 1924.

Patents Recently Issued

Classified Advertising

Of Interest to Farmers

AUTOMATIC HAY SHAKER AND SEED SIFTER.—Adapted for attachment on practically any mowing machine, for separating the seed from the hay, and placing the hay rearwardly on the ground Patent 1598259 J F Shelton, 102 Poplar Ave, Memphis, Tenn

DIGGER ATTACHMENT FOR TRACTORS.—Which can be driven over two adjacent rows of potatoes or the like, for digging and delivering the potatoes at the rear Patent 1592062 M B Sample, Elizabeth City, N C.

HARROW —Having a body formed of a plurality of bars which carry the harrow teeth, and are adjustably connected with one another Patent 1595849 B A Williams, c/o Williams Mfg Co, Watertown, Tenn.

WEED HARROW —Which will operate, when drawn over a harrowed field, to automatically gather weeds from the surface and discharge the same in bundles. Patent 1594,-085 D Wills, Ocean Boulevard, Clearwater, Calif

ATTACHMENT FOR PLOWS —Adapted to be secured to the plow beam after the usual plowshare has been detached, for affording facilities for shallow cultivation Patent 1596825 W J Oates, c/o Oates, Fayetteville, N C

CULTIVATOR-FENDER REGULATOR.—Which can be readily adjusted to various heights at the will of the operator, and be locked in adjusted position Patent 1596111 C L McKelvie, P O Box 246, Fort Collins, Colo.

Of General Interest

COMBINATION CURTAIN, DRAPERY AND SHADE SUPPORT —Which may be easily attached, and easily adjusted to accommodate draperies of different widths without entirely removing the support Patent 1594298. P Machowicz, 174 Russell St, Brooklyn, N Y.

TICKET —Having the numerals printed not only on the obverse face but also in reversed relation upon the reverse face, for preventing forging Patent 1597607 C A Lick c/o Weldon, Williams & Lick, Fort Smith, Arkansas.

MILK BOTTLE.—Which may be stood on either end or placed upon its side and held against rolling, and is open at both ends for thoroughly cleansing. Patent 1595040. T A Voss, Phoenicia, N Y

COMBINED FRAME WINDOW AND SCREEN —Adapted for use interchangeably as a storm window or a fly screen, the interchanging being done without special tools. Patent 1595018. H C Mills, 3250 W 126th St., Cleveland, O

TOBACCO POUCH —Of the flexible type, adapted to be carried in a pocket, and constructed to prevent the gradual discharge of the contents. Patent 1594980 L. and M. Auster, 229 4th Ave, New York, N Y

ELASTIC UNIT —Of the type, comprising a pair of slidably contacting in-elastic members yieldingly connected by a retractile spring Patent 1594062. D B. Jacobs, c/o Diamond X Ranch, Swan Valley, Idaho.

METHOD OF AND DEVICE FOR CEMENTING WELLS —Which separates the cement from the mud during the passage of the cement into the well casing Patent 1594448. A Boynton, c/o Frontier Oil Co, City National Bank Bldg, San Antonio, Texas

TOOTHBRUSH —Especially designed to brush and clean the back of the teeth and between them, and to properly massage the gums Patent 1595715 J M. Dudley, c/o Dudley Bar Co, District Sales Office, Birmingham, Ala

COMPARTMENT PLATE OR PLATTER —In which provision is made for holding several different articles and constructed sufficiently deep to be strong and durable Patent 1595356. J E Mossman, c/o A Baldwin & Co, New Orleans, La.

KNOCKDOWN SCREEN —Which admits of the ready separation or assembly of the parts so that the material may be washed, and the screen conveniently housed Patent 1595929 W P Rhodes, 8418 117th St., Richmond Hill, N Y.

TELEPHONE STAND —For attachment to a wall, the telephone may be swung to one side, and a shelf is included for taking down messages. Patent 1594400 H. Kosmos, 2546 W Monroe St., Chicago, Ill

BASKET —Having a removably attached wire handle which may be locked in operative position or in flat engagement to facilitate shipping Patent 1595800 C L Rickenbrode, Ripley, N Y

WINDOW CLOSER AND RAIN OR SNOW EXCLUDER.—With means for maintaining a window in its open position, and automatically closing the window upon certain conditions in the immediate vicinity Patent 1595951 F Kloniecki, c/o E Carney, 138 W 81st St., New York, N Y

DISPLAY RACK —For displaying merchandise, meats, or similar articles, adapted to be telescoped to occupy a minimum space when not in use Patent 1595882 M. B Sheldon, c/o American Wire Form Co, 265 Grand Ave, Jersey City, N J

SECTIONAL CABINET DOOR.—Whereby any number of sections may be associated, and the doors interlocked to protect and connect all the sections Patent 1595875 H Ruscher, c/o Tieset Office Equipment Co, Grand Central Terminal, New York, N Y

PORTABLE SCAFFOLD —Which can be supported in rigid relation to a pair of ladders, readily assembled, and moved from place to place without disassembling Patent 1593-045. J J Macklem, 5957 South St. Andrews Place, Los Angeles, Calif.

PIE TIN —Formed of sections which may be readily interfitted for baking pie crust, and aiding in forming and maintaining the crust shape Patent 1596331 E N Bassett, 322 Floral Court, Lincoln, Neb.

FOUNTAIN PEN FILLER.—Wherein the usual sack is eliminated and means provided for drawing a quantity of ink directly into the barrel Patent 1596811 A Craig, 150 Cooper St., St. James, L. I, N Y

POSTAL CARD —In combination with an envelope, which serves to conceal an object contained, the post card stiffening and furnishing a little extra protection Patent 1590088. M. H Espey, Rising Sun, Ind.

DETACHABLE ANTISLIP HEEL. — Which may be readily applied to or removed from an ordinary street shoe, insuring a firm ground engaging tread Patent 1596832. C H. A. Heinemann, 186 Paterson Ave., East Rutherford, N J.

MEANS FOR MOLDING MANHOLE FRAMES —Whereby the output is very materially increased, and the work made possible in a foundry, not equipped with expensive machinery Patent 1596815 E F Dooley and G B Scanland, c/o Hutchinson Foundry and Machine Co., Hutchinson, Kans.

TORPEDO —So constructed that its turbine will be incapable of heating beyond a predetermined temperature, thus preventing injury to the turbine Patent 1596845 S. B. Mac Farlane and M Eppley, c/o Marion Eppley, 12 Sheffield Ave, Newport, R. I

LIQUID LEVEL GAGE.—Particularly adapted for oil tanks of ships or other containers where the oil or liquid is partially above and partially below the gage. Patent 1596774 R. Star, 84 Flushing Ave, Brooklyn, N. Y.

TOOTHBRUSH.—By the use of which a more thorough cleansing of all the exposed surfaces of the teeth is insured Patent 1596783 B Weissman, 583 Riverside Drive, New York, N Y

FASTENING DEVICE —For use in fastening gloves, curtains, and others articles where two pieces of material are to be brought together Patent 1596342 E. A. Farron, 1330 Hyde Park Blvd, Chicago, Ill

COMBINATION FLOOR CLEANER AND OILER —Which will serve to take up dust and dirt, will wash the floor, dry the same and oil it Patent 1597644 C Wiener, c/o Betty Clair, 717 Lexington Ave, New York, N. Y

COMBINED SOUND BOX AND SPEAKING UNIT —By means of which sounds may be reproduced from the record of a talking machine or conveyed by radio. Patent 1597647 J Fitzerman, 440 Stone Ave, Brooklyn, N Y.

THERMOMETER AND GAGE TUBE.—Which effects the magnification of the column of

Two More Use "Three-in-One"

THAT a trademark may cover only the line of manufacture of its owner, and no more, is illustrated in the recent decisions in Patent Office oppositions where the Three-In-One Oil Company sought to prevent the Boston Brass Company from registering "3 in 1" and "2 in 1" as trademarks for boiler relief valves and the Lobl Manufacturing Company from registering "3 in 1" for hot water bottles, ice bags and fountain syringes.

"It is the practice of this office to register the same mark in the name of different persons, firms or corporations where the mark is appropriated and used for merchandise having different descriptive properties," rules Assistant Commissioner Moore, "as evidenced by the registration of approximately 75 trademarks, of which judicial notice may be taken, consisting in some instances, of the notations '3 in 1' and in other instances of the notation '2 in 1.'

"The contention that the use of the mark by another, 'even for another class of goods,' would be calculated to rob the mark of its distinctive character and quality and cause the mark to become commonplace, could be made in every case in which the same mark is registered by different parties upon goods having different descriptive properties, and if sustained would result in but a single registration for registration of each mark. This is not the law"

Radio Swamps Patent Office

APPLICATIONS for radio patents are almost overwhelming officials of the Radio Division of the United States Patent Office. In spite of the fact that the number of examiners handling radio patent applications has been nearly tripled, the Radio Division is losing ground before the great influx of requests for radio patents—a greater influx than ever in the history of the office.

The Patent Office has been contending with the problem of an increasing number of radio patents for several years. When broadcasting first began, one division handled all radio, telephone and telegraph patents. But the number of radio applications took such a jump following the popularizing of broadcasting that radio had to be divided into a separate division in August, 1924. There are now 12 assistants in the radio division alone.

Adaptation Is Not Invention

IN converting the "Kiddie-Kar" into a device to teach babies to walk, James L. Carroll is not entitled to a patent, the United States Circuit Court of Appeals for the Sixth Circuit holds in the cases of Frank F. Taylor against the Adrian Baby Carriage Company and the Wonder Manufacturing Company.

"All that Carroll has done," writes Judge Moorman, "is transfer to the Kiddie-Kar certain old parts of perambulators or baby exercisers, with the view of making them more efficient in the uses to which they had heretofore been devoted He has mounted upon a Kiddie-Kar a ring to prevent the child from falling, spread its rear wheels, and substituted for its front wheel a fixed axle supported on wheels. In making the Kiddie-Kar utilizable in this manner for a child too young to be trusted with steering it, he did nothing more than any skilled mechanic could have done. He may have improved the old baby walkers or perambulators, but he has brought nothing new to the art."

fluid, whereby the reading is facilitated from both sides of the instrument. Patent 1597,-698. S. Ligots, 203 W. 62nd St., New York, N. Y.

DOLL.—The legs of which always assume natural positions, whether the figure is seated, or standing on one foot or both feet. Patent 1597600. J. L. Kalius, 1345 51st St., Brooklyn, N. Y.

VANITY-CASE CATCH AND PLATE EJECTOR.—Whereby the compact carrying plate may be easily removed without injury to any part of case with which it is associated. Patent 1597878. W. G. Kendall, 118 Market St., Newark, N. J.

SKIMMER BOAT.—Which makes use of a planning surface for exerting an auxiliary lifting action, affording least resistance, and a maximum speed from minimum power. Patent 1597209. W. C. Schultz, 1878 60th St., Brooklyn, N. Y.

Hardware and Tools

HACK SAW.—Having a handle connected so that it can be adjusted about an axis parallel to the direction of the frame, and firmly secured. Patent 1595035. C. L. Troutman, 225 Wrinkles St., Elyria, Ohio.

WRENCH.—For turning the cups on grease cups, may be applied to a cap of any size within the range of the instrument. Patent 1594072. M. J. Schadeck, Box 93, Spreckels, Calif.

PLUG.—For use in connection with boilers, oil stills or similar capacities, a conical head engaging within an outwardly tapering conical opening. Patent 1595915. J. D. O'Brien, 2 Burling Slip, New York, N. Y.

SAW-FILING CLAMP.—Which is portable, and will dispense with the necessity of securing such devices to a workbench when in use. Patent 1594811. F. J. Bird, 92 7th St., San Francisco, Calif.

COMBINATION TOOL.—Constituting a hammer, a hatchet, wrenches, nail puller, pinch bar, and screw driver in a single useful household instrument. Patent 1596602. H. L. Eagan and O. C. Kinsolving, c/o O. C. Kinsolving, 917 Central Ave., Nashville, Tenn.

OYSTER OPENING DEVICE.—Which is of simple and durable construction, and capable of quickly opening or shucking oyster or the like. Patent 1597622. J. M. Richens, 638 W. 31st St., Jacksonville, Fla.

TOOL FOR APPLYING WIRE CLAMPS.—Conveniently manipulated to secure a wire clamp in place on a hose or like object, and twisting the wire ends to prevent loosening. Patent 1596345. F. W. Gunn, 318 Columbus Ave., Boston, Mass.

PORTABLE DRILL.—Using an explosive mixture as the power element, a closed chamber for the mixture, and a piston acting as an exhaust valve. Patent 1596476. F. Oribier, 68 Hudson Place, Weehawken, N. J.

TOOL FOR REMOVING BOILER TUBES.—Which functions to rip a longitudinal strip from the expanded end of the tubes to allow for withdrawing the same through the crown sheet. Patent 1598458. J. P. Sullivan, 399 Willis Ave., New York, N. Y.

Heating and Lighting

CAMP COOKING DEVICE.—Of light weight, compact storage, easily set up or taken down, and provides a rigid support for cooking utensils over an ordinary camp fire. Patent 1594708. H. M. Briggs, Suite 3, Mansur Block, Houlton, Mass.

WATER HEATER.—Wherein a pressure actuated switch is used to turn on an electric heating current immediately upon the flowing of the water. Patent 1595819. L. L. Bloemlein, Box 623, Hartsdale, N. Y.

GAS HEATER.—In which the radiants are associated with the fire-box to produce a flue through which air circulates, thus preventing loss of heat. Patent 1594744. F. I. Moore, c/o Moore Heater Corp., Long Beach, Calif.

HOT-AIR BLOWER.—Which is easy to manipulate, and whereby a jet of hot air may be directed readily to any desired surface. Patent 1596837. A. Hopkins, c/o Hopkins Mfg. Co, 10 Brantine St., Allston, Mass.

BURNER.—Which utilizes hydrocarbon oil, which is thoroughly mixed and commingled with a highly heated gas before reaching the burner orifices. Patent 1596408. T. G. Van Brunt, 1086 President St., Brooklyn, N. Y.

RADIATOR.—Built up of a number of sections in which the headers are shaped to interlock, thus providing continuous bottom and top portions. Patent 1597062. De Witt T. Lyon, Buena Plaza Apts., 4303 Kenmore Ave., Chicago, Ill.

BURNER.—In which a novel assemblage is provided for spreading the flame and for controlling the flow of air and oil, thus promoting better combustion. Patent 1598528. A. Kals, 5659 Linwood Ave., Highland Park, Detroit, Mich.

STOVE.—In which the heat from one burner may be advantageously utilized to simultaneously heat a number of cooking utensils. Patent 1598339. H. M. Britan, Ojus, Fla.

Machines and Mechanical Devices

FLEXIBLE SKIRT PISTON.—Easily produced by ordinary molding, will effect a perfect fit to the cylinder, and will greatly reduce oil pumping tendency. Patent 1596616. L. R. Davis, 274 Grove St., San Francisco, Calif.

DIESTOCK.—Which is compact in structure and may be used with a hand lever instead of motor driven apparatus, may be quickly adjusted. Patent 1592170. E. J. Wilkinson, 3848 Monroe St., Gary, Ind.

SNOW REMOVER.—In the nature of an attachment for trucks, and particularly suited for breaking up and removing hard crusted snow stored in piles. Patent 1593523. P. Wright, 639 E. Jackson St., Medford, Ore.

MEANS FOR CONTROLLING FLUIDS.—By an arrangement of valves and plungers controlling the direction of flow of steam to "crack" and open the valve and cause the same to close. Patent 1592889. R. F. Knight, Box 345, Ramsey, N. J.

LOOP WHEEL OF CIRCULAR-KNITTING FRAMES.—Having an arrangement whereby to properly determine the direction and the planes of the sinkers of the loop wheel. Patent 1593463. G. Nigra, c/o G. Capuccio, via Arsenale N. 17, Turin, Italy.

CARPET BEATER.—Having means for arresting the movement of the beater element to relieve the device and the operator of unnecessary shock and jar. Patent 1593479. H. P. Thiele, 278 No. 7th St., Newark, N. J.

WASHING MACHINE.—In which the cover may be opened while the device is in operation without first disconnecting any part of the mechanism. Patent 1593716. N. Fox, Emery, S. D.

ELECTORAL APPARATUS.—For collecting and counting votes, by a mechanism by which each voter may see the tally of his own vote, without violating secret balloting. Patent 1593045. C. L. Sturges, 344 Yale Ave., Claremont, Calif.

FLUID-TRANSMISSION MECHANISM.—Which is entirely contained within the fly wheel of an engine, enclosed against dust and injury applicable to motor vehicles or other devices. Patent 1593059. W. C. and A. R. Buckbee, P. O. Box 935, Crockett, Calif.

SEMI-AUTOMATIC TRIP FOR POWER SHOVELS.—Which may be actuated at any time through the manipulation of a lever associated with the control lever of the shovel. Patent 1594629. G. G. Morin, 40 Florence Ave., Holyoke, Mass.

SANITARY STREET CLEANER.—Manually moved over the street, or other surface, and causing a rotary brush to thoroughly clean the surface without raising any appreciable dust. Patent 1595056. E. Boyance and M. Pekary, 600 W. 150th St., New York, N. Y.

POTATO CUTTER.—Operable to produce a novel form of sliced potatoes, in which the product will remain crisp when cooked. Patent 1594990. A. W. Brown, 315 Washington St., Peekskill, N. Y.

PIPE-STRAIGHTENING ATTACHMENT FOR PRESSES.—More especially punch presses whereby such machines may be easily and quickly adapted to the straightening of pipes and tubes. Patent 1594430. T. W. Williams, Oil Hill, Kans.

PRINTING PRESS.—Having inking ribbon mechanism movable over the type bed for the purpose of producing imitation typewritten letters. Patent 1594800. C. T. Spear, Box 378, Texarkana, Texas.

COUPLING CONNECTION FOR PUMP RODS.—Adapted to be releasably secured to a vertically reciprocable part in connection with the mechanism of a windmill. Patent 1594,-784. A. L. Ligon, Longfellow, Texas.

MECHANICAL MOVEMENT.—For converting a rotary motion into a reciprocatory motion for reciprocating a shaft and rotating the same. Patent 1594556. J. W. Pitts, 97 Owens Ave., Detroit, Mich.

SCREEN.—Adapted particularly to a perforated well tube for preventing the passage of sand and small stones between the tube and the screen. Patent 1594788. M. J. McLaughlin and D. J. Harrison, c/o Huggins, Kayser & Liddell, Chronicle Bldg., Houston, Texas.

ROD COUPLING.—Which will efficiently hold together the ends of rod sections, and may be quickly applied or detached therefrom. Patent 1594698. E. R. Thomas, Denoya, Okla.

DEEP AND SHALLOW WELL CYLINDER PROTECTOR.—Having means for preventing rust scale, sand, etc., from interfering with the operation of the plunger and valves. Patent 1594745. A. B. Mueller, 103 Isabelle St., San Antonio, Texas.

PROCESS FOR SEPARATING HYDROCARBONS FROM OIL BEARING EARTH.—By means of water steam and agitation in a closed container and correlated open containers. Patent 1594796. G. J. Rockwell, 138 So. Stafford Ave., Huntington Park, Calif.

MACHINE FOR SECURING HANDLES TO BASKETS.—For containing grapes, etc., providing means for securing the handle terminals adjacent the rim and clinching them in position. Patent 1595808. C. L. Rickenbrode, Ripley, N. Y.

APPARATUS FOR DRYING EGGS.—Whereby the resultant product will be more soluble than is usual, particularly such products as albumen and whole eggs. Patent 1595,-778. U. S. Harkson, c/o Henningson Bros., 105 Hudson St., New York, N. Y.

APPARATUS FOR PEELING ARTICLES.—Such as vegetables and fruits, by a direct application of heat, without damaging the bodies of the articles. Patent 1595954. J. Q. Leavitt, P. O. Box 364, Ogden, Utah.

PISTON RING.—In which means of connection between sections is provided to lock the same together for radial expansion or contraction. Patent 1595890. C. H. Taylor, Biloxi, Miss.

GATE.—Having mechanism adapted to be operated without the driver of a vehicle having to dismount or stop the vehicle as it passes through. Patent 1595524. M. H. Poole, 515 7th Ave., So., Great Falls, Mont.

LUBRICANT CUP.—With spring pressed plunger, automatically regulating the flow of lubricant, whereby the volume will be practically constant. Patent 1595157. H. E. Hoover, Route 8, Wabash, Ind.

CORER.—For apples, tomatoes and other fruits or vegetables, the apparatus will not only cut a circular opening but will sever the core. Patent 1595953. J. Q. Leavitt, P. O. Box 364, Ogden, Utah.

TYPE BAR MECHANISM.—Which will provide for power where needed, and speed of movement where speed and not power is most desired. Patent 1595847. A. N. Woodruff, Box 1907, Washington, D. C.

CLUTCH.—Especially adapted for use in well drilling, providing an internally expanding clutch capable of adjustment to compensate for wear. Patent 1594105. J. W. Miller, 311 No. Raymond Ave., Pasadena, Calif.

Pertaining to Vehicles

VARIABLE-SPEED-TRANSMISSION MECHANISM.—Which can be adjusted while the drive member is rotating to render the mechanism ineffective, or to give varied speeds. Patent 1594753. E. B. Rayner, Box 361, Piqua, Ohio.

ATTACHABLE BLADE.—Adapted to be applied to different types of non-skid chain devices, such as are used for automobile tires. Patent 1594950. A. G. Hartung, c/o G. Breuer, Maipu 671, Buenos Aires, Argentina, S. A.

DEVICE FOR MOUNTING DISK VEHICLE WHEELS.—By which the wheel may be slid easily to bring the stud openings in the disk in registration with the studs carried by the hub. Patent 1595930. L. I. Sieven, 1461 45th St., Brooklyn, N. Y.

HEADLIGHT FOR MOTOR VEHICLES.—In which two sources of light and two reflectors are employed in each unit each focused upon different portions of the road ahead. Patent 1595179. R. B. Stiert, Box 235, Sapulpa, Okla.

AUTOMOBILE HEADLIGHT CONTROL.—Actuated by the movement of the steering wheel, throwing the light upon the road in the direction of turning. Patent 1595879. H. Schjots, C. Stangaard and F. Schlueter, 6781 Vinewood Ave., Detroit, Mich.

CLAMP.—For exerting pressure on tires during vulcanizing, the maximum of pressure being exerted at a plurality of points by a single means. Patent 1595914. E. Nestler, 245 W. 55th St., New York, N. Y.

TRAILER HOIST AND COUPLER.—Which will transmit power from the engine of the tractor to one end of the trailer for raising or lowering the same. Patent 1595902. W. Mayer, 2 B. E. 5th St., Brooklyn, N. Y.

UNIVERSAL WHEEL DRIVE.—Particularly as applied to the front wheels being dust proof, rugged, compact and having little influence on the steering. Patent 1594103. M. G. McNeely, Box 201, Fruitvale Station, Oakland, Calif.

AUTOMOBILE LOCK.—For use in connection with the steering apparatus by means of a permutation lock thereby avoiding keys. Patent 1594091. J. Clifford, 1039 62nd Ave., Oakland, Calif.

DIMMER FOR AUTOMOBILE HEADLIGHTS.—Immediately associated with the reflector, breaking the light rays at their source rather than while passing through the lens. Patent 1594075. L. J. Smythe and A. Kerr, Fairbanks, Alaska.

STEERING WHEEL THROTTLE AND SPARK CONTROL.—Which may be operated by the driver's hands without in any way shifting the position of the hands on the wheel. Patent 1593876. R. Learmont, Box 9, Boorowa, New South Wales, Australia.

MOTOR VEHICLE WHEEL.—More particularly of the disk type, for facilitating the holding, removal, and replacement of pneumatic tires, and preventing rotary movement of the disk. Patent 1596097. L. W. G. Grieves, c/o Grieves Rapid Demountable Lock Wheel Co., 91 Queen St., Auckland, New Zealand.

VENTILATING DEVICE FOR VEHICLES.—In which means is provided for conveying fresh air into closed vehicles and forcing the foul air out, without causing a draft. Patent 1596094. A. Mortimer, c/o Michael Clancy, 8258 S. Green St., Chicago, Ill.

DEVICE FOR USE IN ADJUSTING FOOT BRAKES.—Which holds the foot pedal of an automobile in proper position while tightening the nuts on the springs of the brakes. Patent 1596834. P. Herbert and J. M. Withee, Box 149, Rumford, Me.

PUMP.—For forcing air into an automobile tire, and having novel means for supplying lubricant to the moving parts of the pump. Patent 1596358. R. D. Hughes, c/o Red Giant Tool Corp., Lynchburg, Va.

ANTISKID DEVICE.—In the form of an attachment for vehicle wheels, especially automobiles, for use when the pavement is ice coated. Patent 1596796. K. R. Blum, 2345 Broadway, New York, N. Y.

VEHICLE RUNNING BOARD.—By means of which dirt and the like may be scraped from the shoes before entering the car. Patent 1597638. C. L. Vincent, 79 Carmel St., New Haven, Conn.

ANTISKID CHAIN.—Which can be readily adjusted to any ordinary tire, and provides means for taking up slack after the device is positioned. Patent 1597596. C. A. Hartfiel, 2098 Lexington Ave., New York, N. Y.

TRAVELING ADVERTISING DEVICE.—In the form of a vehicle, which affords facilities for supporting a plurality of rotary display units operating at spaced intervals. Patent 1597202. J. H. Bloodgood, 3210 No. A St., Tampa, Fla.

AUTOMOBILE DIRECTION SIGNAL.—A simple unit which can be readily attached to or removed from, an automobile, and operated from an enclosed car. Patent 1597624. S. Schumel, 8414 89th St., Woodhaven, L. I., N. Y.

TRAPDOOR FOR AUTOMOBILE FLOORS.—Which may be applied to any part of the floor, readily opened and automatically closed, or adjusted to remain open. Patent 1597509. G. W. Barringer, Lawrence, N. Y.

Designs

DESIGN FOR A DOLL'S CRADLE.—Patent 70700.—E. Hollebeck, Davison, Mich.

DESIGN FOR AN AUTOMOBILE SIGNAL CASING.—Patent 70770. J. Martin, 440 Lewis Ave., Brooklyn, N. Y.

DESIGN FOR A BOX.—Patent 70774. F. A. Purchas, McGraw, N. Y.

DESIGN FOR A WOVEN FABRIC OR SIMILAR ARTICLES.—Patent 70782. L. Bluhm, c/o Phoenix Mfg. Co., 40 Thomas St., New York, N. Y.

DESIGN FOR A BOX.—Patent 70807. F. A. Purchas, McGraw, N. Y.

Our Book Department

The Story of Steel

By J. Bernard Walker

Editor Emeritus, Scientific American

If one were asked to name the most important industry in the United States, he would be safe in naming that of steel. To put this thought in the words of the author of the above book: "If the writer were asked to name the principal agent in the enormous growth in wealth of this country during the past two decades, he would unhesitatingly name the vast iron deposits of the Lake Superior region and the consequent phenomenal growth of our steel industry." Nature was extraordinarily generous when she was preparing the territory of the United States as a habitation and development of man. Nowhere in the wide world is to be found such an aggregation of rich, natural resources—forests, soil, rivers, water power, coal, and oil, to say nothing of minerals. Of all these, perhaps the most amazing, we had almost said sensational, is the enormous deposits of unusual rich iron ore averaging 50 percent pure iron which extends for one hundred miles or more north of and parallel with the north shore of Lake Superior. "The Story of Steel," is an attempt to deal with the larger aspects of the vast steel industry in such a way that the reader—whether he be technically instructed or not—will be particularly informed upon a subject of universal interest. Preparatory to writing this book, Mr. Walker made an extended trip throughout the properties of the United States Steel Corporation and his story is based upon what he saw throughout this journey of several weeks duration. From the mining of the ore in the Missabe Range where the famous Hull Rust Mine opens its huge gap—an excavation many times larger than the Culebra Cut, Mr. Walker follows the ore to the vast ore docks, where on a test some 14,000 tons have been loaded into a ship in 16½ minutes, then accompanying the ore on its trip down the Great Lakes to the blast furnaces at Lorain, Gary and elsewhere. Separate chapters are given to the smelting of the ore in the blast furnace, the treatment of the molten iron in the Bessemer converter and in the open hearth furnace and the electric furnace, to turn it into steel in the shape of the ingot. Then follow a series of chapters on the manufacture of the steel into the principal finished products of the steel industry. The human side of the industry is dealt with in chapters on safety and general welfare work. Although the study upon which this work is written was confined mainly to the activities of the United States Steel Corporation, the general practice in steel making is so similar throughout the industry that these chapters may be taken as truly representative of the industry as a whole. The style of the book is characterized by the clarity of diction and touch of imagination which distinguish the author and the immensity of the various plants and the truly sensational size of the machinery employed are here vividly and entertainingly set forth. When it is borne in mind that the steel industry is turning out finished products at the rate of over forty million tons per annum, it will be realized that a large force and much knowledge and skill is needed in distributing this huge tonnage from the time it reaches the loading platforms at the finishing end of the mills. This important work is described in a chapter entitled, "Distributing the Finished Product." The last two chapters on the marketing of steel and the financing of the industry, written by Edmund Brown, Jr., add greatly to the value of this work. Published by Harper Brothers.

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November 1926

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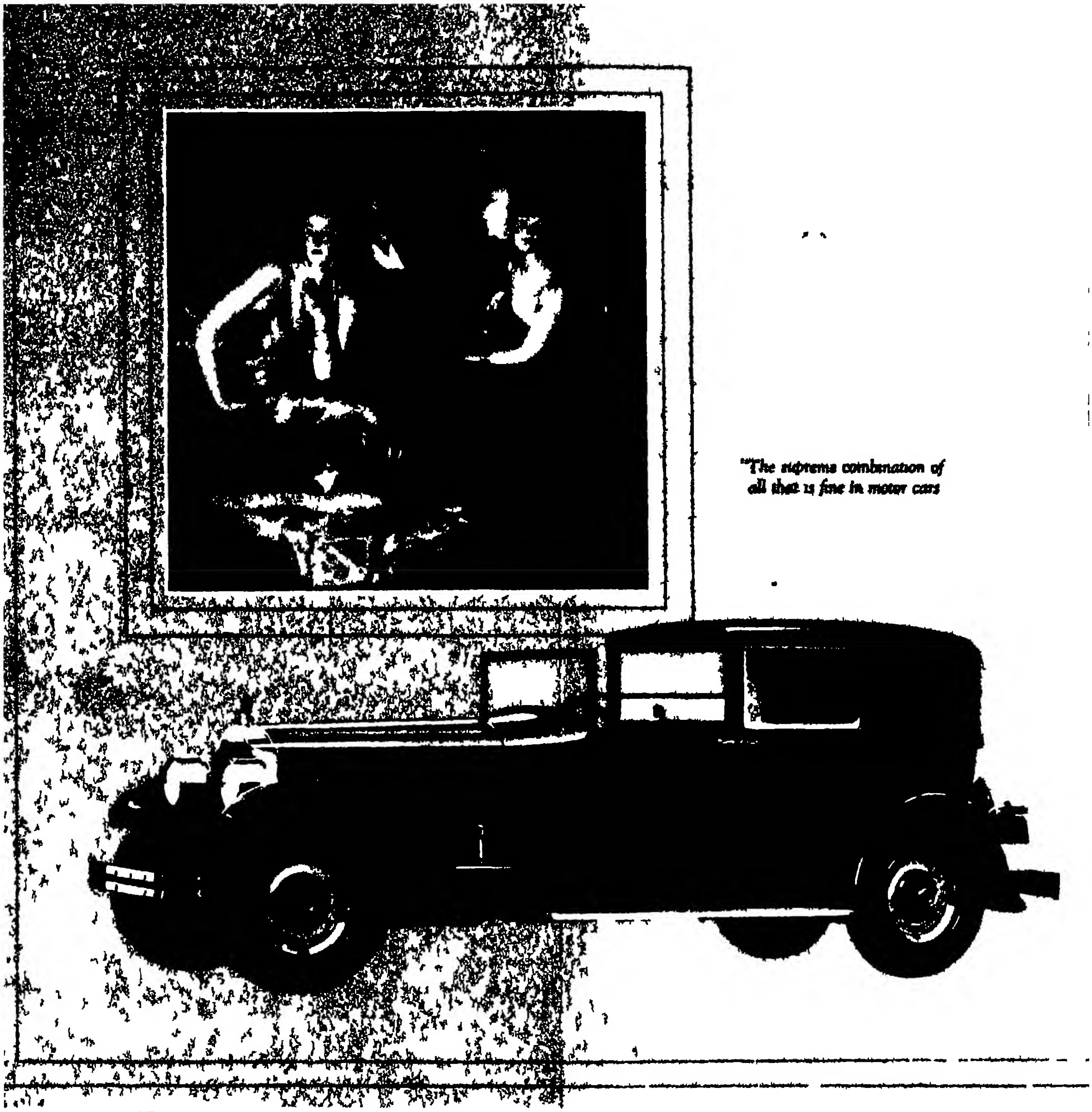

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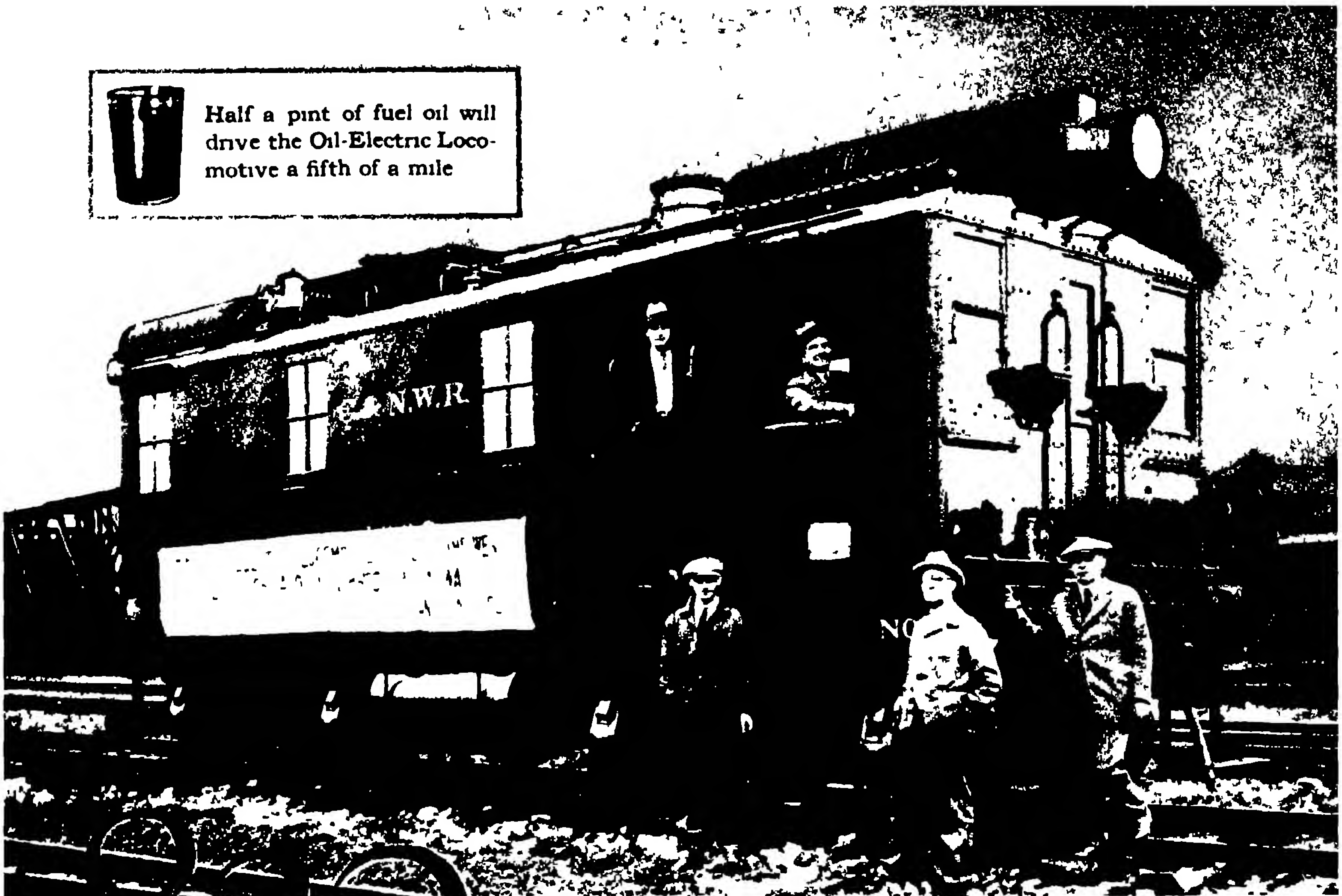

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391-8

GENERAL ELECTRIC

SCIENTIFIC AMERICAN

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By C. P. Burgess

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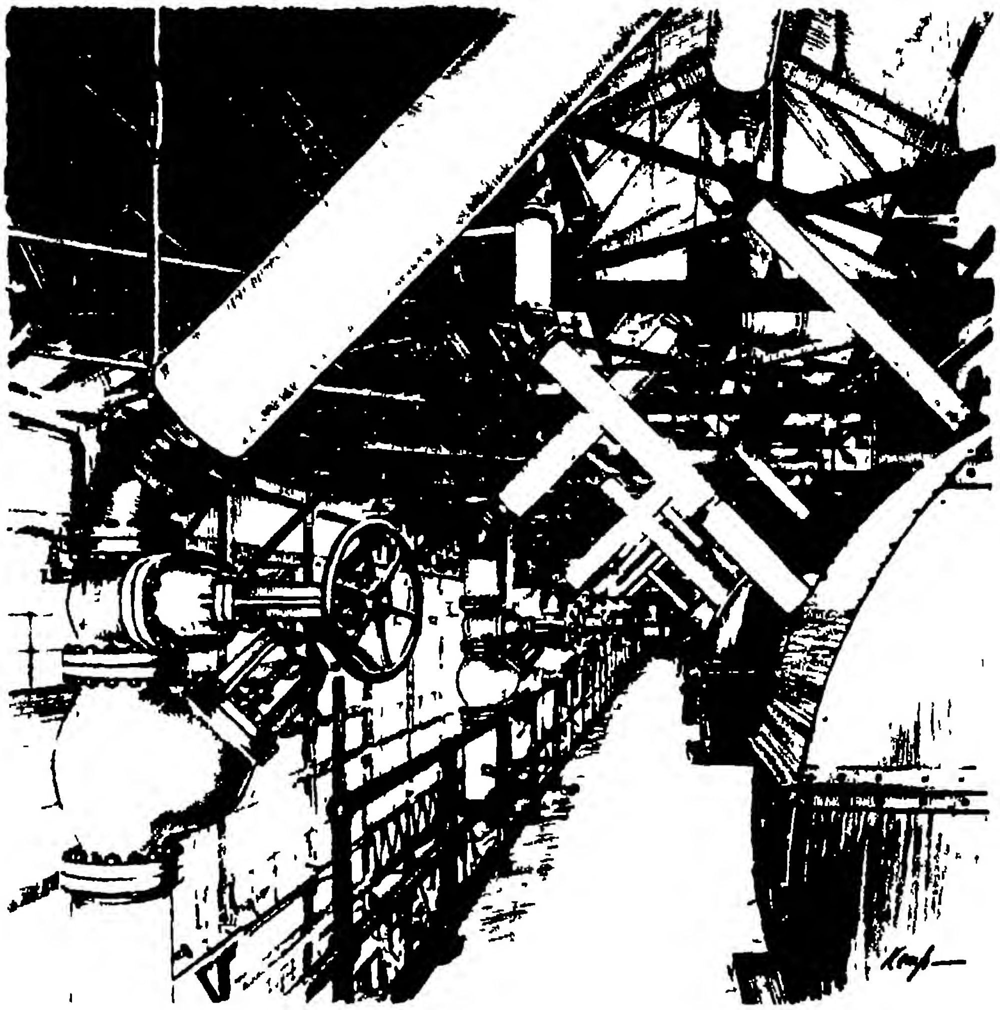

Carnegie Steel Co. chooses Crane cast steel

A Crane shower with volume regulator to meet variations in water pressure

Historians, marking man's progress by his use of metals, call this "the age of steel" The story of its utilization, from the days of the Toledo sword-blade to our sky-scrapers and ships and mighty river spans, is a romantic epic of advancing knowledge Today, the high tribute to any material or product is to say that it is as strong as steel

Among the pioneers in this country to produce cast steel valves and fittings was the Crane Co With characteristic thoroughness, the best methods of manufacture have been carefully evolved To enable the exact control of temperature which Crane deems essential, only electric furnaces are used Every step in the production process is paced by chemical analysis. The molds of very refractory sand are baked, and the flasks are extra deep to allow generous risers, insuring tight, solid castings Finally, correct annealing and slow cooling relieve internal strains and give fine, even grain

Hence, it is not surprising that for their power houses, the masters of steel choose valves and fittings of Crane electric cast steel. In your own plant, its unfailing dependability may do no more than insure safety by the widest possible margin Or for your home, you may need simply a sink faucet or a radiator valve Always, if it is quality you want, specify Crane.

Above a view in the Carrie boiler house of the Carnegie Steel Co , Rankin, Pennsylvania, showing boiler leads and main steam header The valves and fittings are of extra heavy Crane electric cast steel B Floersheim & Co , Pittsburgh, were the piping contractors.

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SCIENTIFIC AMERICAN
THE MAGAZINE OF TODAY AND TOMORROW
NEW YORK, DECEMBER, 1926 — Edited by ORSON D. MUNN — EIGHTY-SECOND YEAR

CHEMISTRY

BELIEVING that there is no field in industrial effort today more fraught with possibilities than chemistry—more particularly industrial chemistry—it is with much satisfaction we announce that beginning with our January issue, D H Killiffer, Secretary of the American Chemical Society, who is intimately in contact with all that transpires in this field, becomes a regular contributor to the Scientific American He will have a department in which will be noted each month the latest announcements and facts of interest upon which authoritative comments will be made.

THEORIES

WE receive about a dozen theories a day from people all over the world Theories of this, theories of that, theories of everything from a sub-electron to a hyper-super-universe They arrive, generally, in the form of an elaborately prepared manuscript on which someone has put literally hundreds of hours of thought and preparation, most of which is wasted.

Our readers do not see these theories for few if any of them come to us supported by actual laboratory test. The ancient Greeks attempted to reach truth by reasoning alone but they went far astray. Modern science says, "Ask Nature by making an experiment." This, few of these theorists seem to find necessary.

When, however, a theory has run the gauntlet of the various scientific societies which are made up of professional scientific men, and has at least received considerable notice—even if not acceptance—*then* we often publish a résumé of it, accompanied by a frank statement concerning its present status.

BAIT

WHAT bait would you use to catch a mountain lion?

Catnip!

The Biological Survey is using it. According to Dr. A K. Fisher of the Economic Investigation Division of the Survey, catnip has a peculiar lure for all members of the cat tribe, except the cheetah of India. One drop of oil is diluted with 20 drops of petroleum, the dilution, as in the case of attar of roses and other perfumes, increasing the odor. A drug firm in New York has been urged to produce catnip oil not only for the Survey but for private individuals who desire to trap wild animals.

It only goes to show that domestic felines are no more distant from their wild cousins than we civilized humans are from ours.

In This Issue

Germs That Carry Lamps
Fireflies, glow worms, luminous fishes and other animals produce their own lights Even some bacteria do it and they do it more efficiently than man does it with his electric lamps New research has thrown more light on these tiny torch bearers. The story is told on page 411.

Planning Still Larger Airships
Government technical bureaus have designed two giant airships for the Navy, twice as large as the *Los Angeles*, and with a radically new design—short, fat and "buxom" They will be filled with helium, armed to the teeth and much stronger than the ill fated *Shenandoah* On page 418 a government authority explains the new plans of our Navy

Not a "Death Ray"
A remarkable new cathode-ray tube which kills small animals has just been announced in the press Already many erroneous and even ridiculous statements have been made about it On page 420 you will find a thoroughly accurate, authentic account of this marvel, with the sensational nonsense left out

Golf Controversy!
When golf fans fall into an argument the rest of us stand back and watch the fun as the fur flies. That is what has happened in the columns of the Scientific American In our August issue Professor H H Sheldon said one thing—now a golf ballistician says another Turn to page 426.

MORE THAN 200 PICTURES

Complete table of contents will be found on page 478.

For Next Month

Brains
Nobody knows yet how we think; there are only *theories* But we are rapidly learning more and more about the development of that marvelous organ called the brain Next month Professor G. Elliot Smith of the University of London, famous anatomist and authority on human evolution, will contribute an article, revealing new knowledge concerning the brain.

What Tires a Tire?
Largely heat—the heat generated when the tire bends at each turn of the wheel This heat gradually overcures the tire and it becomes decrepit. New ways are being sought—and found —to overcome this Next month D. H Killifer, well known chemist, will explain them.

Telepathy, Mind-Reading: Fake?
Sometimes, at least, it is When demonstrated on the stage it is quite certain to be faked. How the professional mind readers that circulate among the audience and read their minds actually signal to their confederates on the stage forms the nucleus of a brilliant account by Dr. Walter Franklin Prince, Research Officer of the Boston Society for Psychic Research.

Other articles on Fossils in Illinois, Inventors Who Have Made Good Commercially, Children of the Sun, How the Bullet Identifies the Criminal; Wheels Made from Steel I-beams; Unit Automobile Bodies, The Rising Tide of Insects, Astronomy; Radio

MORE THAN 200 PICTURES

EVOLUTION

WE told you so!

We predicted that the Tennessee evolution trial would boom evolution among the masses It has Read this, from the New York *Times* "Frank Cummings went to jail again yesterday for stealing a book It was Darwin's 'Origin of Species' He told the magistrate his interest in evolution dated from the 'Monkey Trial' in Tennessee"

Until that famous event warmed up the cooling evolution controversy it is safe to say that Cummings did not know what evolution meant And now he is in jail for his zeal concerning it! We hope he will there be given the full opportunity to read "The Origin of Species" To be frank, we have read more lively works on evolution Perhaps, though, if we were sent to jail !

WARNING

THOSE human blood-suckers, the promoters of worthless stock-jobbing corporations, are now said to be getting ready to capitalize the unusually great volume of recent newspaper talk concerning American rubber growing potentialities. Guayale, a Mexican shrub, is to be the bait, thinks the *India Rubber World*

Guayale will furnish rubber, although too much by far has been said in its favor What the small investor may omit to see is that a corporation, organized ostensibly to exploit rubber, may possibly regard this as the last thing it intends to do To sell stock there must of course be a plausible pretext And now that the people have been hearing a good deal about rubber, that commodity furnishes a glorious pretext for the crooked stock jobber

LOCOMOTIVES

THE newest locomotive of the New York Central Railroad, Number 1200, during a recent test, pulled a train of 108 freight cars at a speed of 32 miles per hour without the least indication of strain Although this new leviathan of the rails is of the electric type, she calls to mind one of the former crack engines of the same road, Number 999 Over 30 years ago, this engine set what is believed to be still a world's speed record by traveling at a rate of 112.5 miles per hour Number 999 is now retired and on exhibition, but about five years ago, she had been superseded in passenger work and had been reduced to the lowly occupation of hauling milk trains over the same rails that she once ruled This prompts the thought—what manner of engine will surpass the power of Number 1200, and what will be her final occupation in railroad service?

© The New York Edison Company

Thomas Alva Edison, One of the First Radio Experimenters

In the year 1875, Edison conducted a series of experiments with a form of electricity that had not been known before that time So new and so unusual were his results that the now great inventor gave the name of "etheric force" to the discovery Little did he think at the time that he was hovering on the brink of a system that within the span of his lifetime was to make possible communication around the world without the use of connecting wires It is to be regretted that Edison did not further his experiments, for if he had done so the development of radio communication might have been speeded up by many years. Later in his career the wizard of electricity as he has come to be known, discovered that an incandescent electric light bulb was doing more than giving out light He found that the filament was producing a quantity of electrons and that the electron stream would carry a current of electricity But here again he stopped just short of a master achievement and left the development of the radio vacuum tube whose functioning depended on the electron stream that he had discovered, to later investigators It must be remembered however that in radio as in many other fields, Edison has blazed the way

© ... London News

Looking Straight Down on the Crater of Mont Pelee

"What does Mt Pelee look like now?" one is prompted to ask when the terrible outburst of that volcano is spoken of. It was on May 8, 1902 that this volcano situated on the West Indian Island of Martinique, burst into a great eruption which utterly overwhelmed the city of St Pierre, killing 40 000 and sparing but a single soul, a man who had taken refuge from the fiery blast in a masonry structure. Today we may fly over the grim crater in an airplane, observing its nearly quiescent cauldron. In the illustration, taken from a height of 4,000 feet above the summit, or 8 000 feet above the level of the sea, a cooled and hardened stream of lava may be seen. At numerous places small areas still show slight activity in the form of steam and gases, while the crater's rim shows distinctly, broken in only one part of its circumference.

The Multiple Eyes of Insects

Insects Have Many Eye-lenses. Do They See a Separate Image with Each Lens, or a Single Image as Does the Human Being? Recent Experiments Show that Certain Established Beliefs About Insect Vision Are Wrong

By H. Eltringham, M.A., D.Sc.

How does the insect see? Does it see what you or I see, and in the same manner, or is there a generic difference between human eyesight and that of insect life? Offhand, perhaps, one might say there is only one way to see, and that is to see things as they really *are*. A little thought should soon convince us, however, that even we do not see things in that manner. A box, for example, may be a cube, yet do our eyes not tell us it tapers away from us? True, our brain, accustomed by experience to dealing with such things, *interprets* this erroneous impression and assures us that the box, which our eye saw in perspective, is cubical.

Now, when we come to the vision of the insect, we find that Nature could not provide it with eyes of the kind large animals have, for the insect is too small. This raises an abstruse matter, involving the physical principle of "resolving power," here we can simply state that the larger the eye lens, the finer the distant detail that it can resolve or descry. Whatever method the insect uses must, then, dodge the question of resolving power. The insect eye is made compound and the image is a mosaic of light and dark dots. In the euconic eye such as that of the bee, the effect is something like our own vision, except that the lenses are so small in aperture that rays of light from closely adjacent distant points form overlapping images and the detail of the object is unresolved. Some insects fly rapidly past an object, getting several images of it. This gives them a directional sense. —*The Editor*

THE eyes of insects differ from the single lens eyes of vertebrate animals in having many lenses or facets. This fact has long been known and many attempts have been made to discover exactly how an insect sees.

Our own eyes produce on the retina or nervous layer at the back of the eye an inverted image of the whole field of view just as does a camera lens on the film or focusing screen at the back of the camera. Through interpretation based on experience we are not conscious that we see everything upside down.

In the eye of an insect each lens undoubtedly produces an inverted image and early experimenters having seen these images by looking at the back of the layer of lenses with a microscope not only concluded that the insect must see a multiplicity of inverted images, but they photographed these images and published the result as a reproduction of the kind of view an insect obtains.

It was of course necessary to suppose that the nervous mechanism combined all these images into one. In spite of excellent anatomical research by Grenacher and others, the first really reliable information concerning the action of insects' eyes was given by Exner, who worked out both practically and mathematically the true action of the facets of these compound eyes.

Two Kinds of Insect Eyes

Figure 1 shows a section of the eye and part of the brain of a small "tortoise shell" butterfly. At A is the external or corneal layer, consisting of a great number of lenses about 5,000 to 6,000 in each eye. Lying beneath each of these lenses is a secondary lens called the cone. The cones (C) are embedded in a mass of pigment which serves to prevent the light rays which enter one cone from interfering with those entering adjacent cones. Each cone tapers off into a delicate transparent rod (called the rhabdom) which passes inwards towards the brain and ends near the membrane E. The area occupied by these rods is marked D. At B there is a thin layer of transparent material separating the lenses from the cones. Packed round each transparent rod are eight slender nerves which can best be seen in a transverse section. These nerves pass in bundles (F) to the brain in which are found the two optic ganglia, G and H.

Two kinds of cones are found in insect eyes. The first found in the eyes of flies, dragon flies and other insects are called pseudocones or false cones and they are of a soft semi-fluid material. The second kind are found in the eyes of beetles, butterflies and probably bees, wasps, et cetera. These cones are harder and of a material resembling that in the lenses. They are called eucones.

Now it can be shown that while the pseudocones have little optical effect except the mere concentration of light the eucones have a remarkable

CROSS SECTION OF BUTTERFLY'S EYE AND BRAIN

Figure 1. The curved external layer of the ... arranged the whole top and right side of the picture. The brain lies below in the center. Between the ... the several parts explained in the text at the left. A butterfly's eye is quite different from that of an ordinary fly

property. Their refractive index varies from the center to the periphery, and Exner has shown that they receive the inverted image from the lens and not only reinvert it but pass the resulting erect image down the transparent rod in the form of parallel instead of divergent rays.

Figure 2 is a diagram of a single element of a butterfly's eye. L is the lens, T the layer of transparent material, C the cone, R the transparent rod and N the nerves. There is also an arrangement of air tubes by which each nerve has its own air supply but these are omitted from the drawing. To the right are shown sections at different levels.

Let us study the pseudocone eye first. Each lens does not take in the whole field of view but only a very small part of it. Indeed owing to the isolation of the cones by the pigment only the rays of light which fall nearly perpendicularly on the lens can penetrate to the nervous system. In other words each lens records only its own minute portion of the whole field of view and of that it forms a very small inverted image. As an *image* it is of no value because the cone not having the resolving power of a lens merely records the result as a minute spot of light pale or dark, according to the average value of the light received by the lens. If one element or facet thus merely registers a dot of light the whole series of elements will merely record a great number of light spots of varying intensity. How then can the insect see?

Flies See "Half-tone" Images

The reply is that provided the elements or facets are sufficiently numerous there is no reason why it should not see very well although only for a short distance. A picture made up of light and dark dots is so familiar an object that we cannot look at an ordinary illustrated newspaper without seeing an example. Figure 3 shows two portraits which were produced in this way. It will be seen that one is rather coarse being produced by a comparatively small number of dots while the other is much finer in both shading and definition although it is also produced by minute dots. The only difference is that in the finer portrait the dots are much more numerous.

There can be little doubt that insects such as flies and dragon flies which have pseudocone eyes receive just this sort of image on the nervous layer at the back of the eye and of course the image so formed is erect and not inverted. The evident keen sight of a large dragon fly is due to the great multiplicity of the facets in its eye. Some dragon flies eyes are said to have over 20,000 lenses. These and other insects cannot however see distinctly at any great distance. It can be shown that the number of facets engaged in viewing a given object varies inversely as the square of the distance between that object and the eye. This means that supposing 100 facets are engaged in forming the image of a certain object one inch away at two inches only a quarter of that number or 25 would be available while at

three inches only about 11 facets would be used The dot image therefore becomes rapidly coarser and less well defined

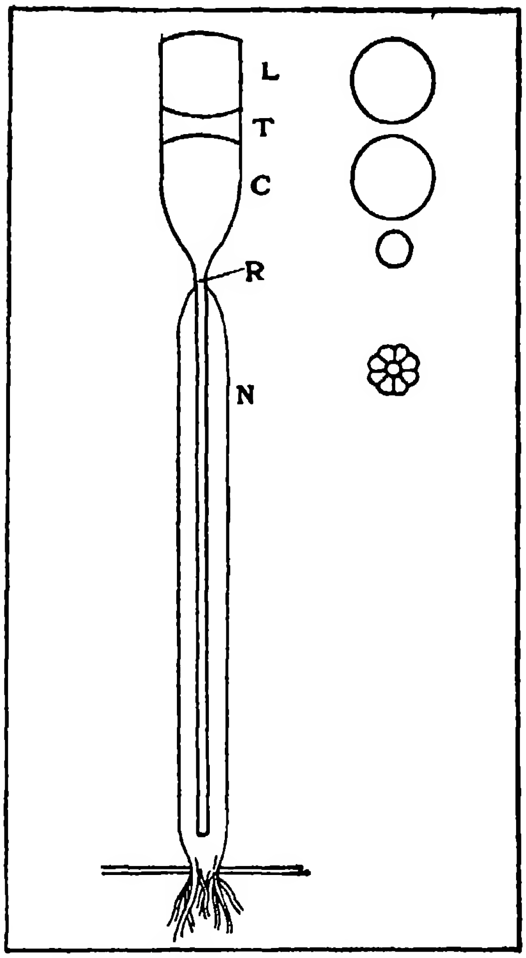
Now let us consider the eucone eye. Here the cone has a definite optical effect and, as has already been stated it is here is the image formed by the lens so that at the point or inner end of the cone there is a minute but erect image of that part of the field of view included in the angle of the lens Obviously a large number of such small erect images will make up a complete erect image of the whole field just as a set of toy blocks will when arranged in the proper order reproduce the whole original picture from which they were cut Exner succeeded in demonstrating this fact by means of his discovery that in the eye of the glow worm the cones are so firmly attached to the lenses that the nervous and pigmentary substances can be cleared away from the back of the eye and the purely optical apparatus examined in an intact condition

Are Insects Color Blind?

By mounting such a prepared eye on a minute drop of dilute glycerine having a similar refractive index to that of beetle blood and focusing at the plane of the nerves, while some object was placed in front of the outer surface of the eye he was able to see the image and also to photograph it The present writer has repeated some of Exner's experiments, and Figure 4 is a micro photograph of a portrait, taken through a glow worm's eye in the manner described The actual area of the image is only about 15 of a square millimeter so that in enlargement, much of the definition is lost In the actual eye the view of any external object is remarkably clear

The eye of a butterfly can be shown to act in much the same way although owing to the delicacy of the cones, it cannot be prepared so as to furnish a suitable image for photography

There has been much discussion in the past as to whether insects can distinguish colors although the question put in such a way is too vague to admit of a concise reply No doubt many insects would have no use for the power of color vision but butterflies associated as they are with their own colors and those of flowers would scarcely be expected to be color blind At least one experimenter has however asserted with an alleged weight of evidence that all insects including butterflies are color blind Space will not permit of a description



SINGLE ELEMENT OF A BUTTERFLY'S EYE

Figure 2 Highly magnified this is a single one of the elements shown in Figure 1 from A to E L is the tiny lens T the transparent layer C the cone R the transparent rod and N the nerves At the right of this drawing are shown cross sections of each of these parts

of the somewhat lengthy experiments carried out by the writer in the endeavor to throw some light on this subject However a brief summary may be given

Inability to see red is one of the commonest forms of color blindness A pure red transparent dye was therefore painted over the eyes of some tortoise shell butterflies Had the insects been blind to red they would thus have been altogether blind since none but red rays could reach the nervous layers of the eyes They did not prove to be blind when so treated, since they flew to the light, and when liberated could fly in a purposeful manner and alight with precision

In a further experiment, a large bed of asters was chosen as a test, and it was found that the purple asters were the most conspicuous to the human eye on account of their color The butterflies also selected the purple asters in the majority of cases Photographs were then taken of the flowers, using a succession of screens which cut out portions of the spectrum, so that the plates were rendered blind to red, blue, green, yellow and so on In every case the photograph showed the purple asters to be *less* conspicuous than when all the rays of light were in use

Butterflies Can Distinguish Colors

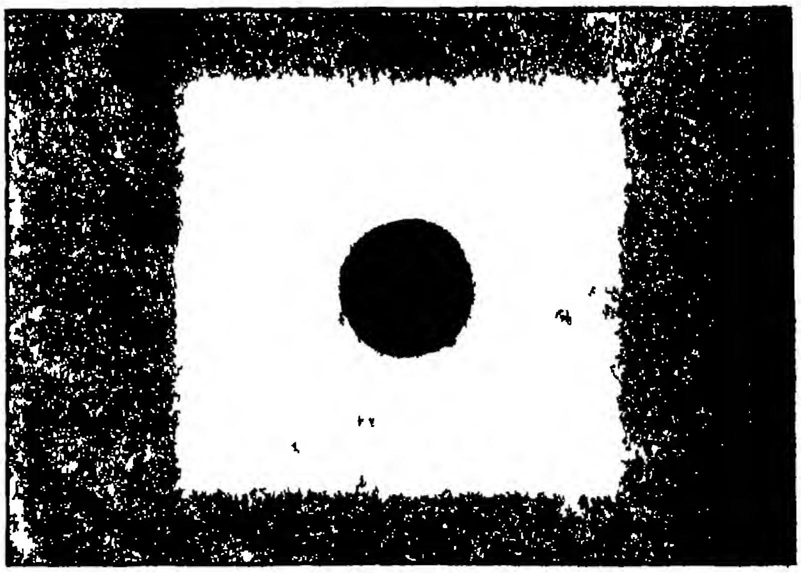
Paper models of a small "fritillary" butterfly were set up where the insects themselves were common Dead and dried insects of the same species were also used, and some of both the paper and the real models were dyed all kinds of unnatural colors Not only did the live insects pause over the naturally colored models *only*, but in more than one case, a butterfly stooped to and examined a single broken wing of one of the dried specimens which had been thrown on the ground, although there must have been many small objects lying about which were of the same luminosity but not of the right color In one case a butterfly did examine another object on the ground, and this proved to be a golden bronze bud scale of exactly the same color as the insect itself In only one case was an unnaturally colored model noticed at all This was late in the day when the butterflies were feeding on the blue "bugle" flowers, and the model examined was a blue one, showing that the insect had momentarily mistaken it for one of the flowers

These and other experiments, together with a full account of the anatomy of insect eyes will be found in the author's paper on "Butterfly Vision" in the Transactions of the Entomological Society of London for 1919

The huge yet almost human machinery that aids in turning out all steel automobile bodies in practically one metallic unit will be described and illustrated in a forthcoming issue

HOW SOME INSECTS SEE—A MOSAIC OF SPOTS

Figure 3 Halftone illustrations that give an idea of how an insect sees objects Both are composed of minute dots In one the dots are simply larger than in the other The distance between the dots represents the limit of fine detail which the insect can descry To grasp the kernel of resolving power consult any college physics text book It governs ultimate seeing in telescope eye and microscope



TAKEN THROUGH THE EYE OF A GLOW WORM

Figure 4 This micro photograph is greatly enlarged which accounts for its blurred outline It is therefore not the exact way an insect sees The original from which it was enlarged photographically was actually smaller than this period Some insects get a very poor idea of objects farther away than about one foot A spider however can see you clearly The same is true of the bee who can see flowers from afar

The Month in Medical Science

A Review and Commentary on Progress in the Medical and Surgical Field

By Morris Fishbein, M.D.

Editor of the "Journal American Medical Association and of "Hygeia," the Health Magazine

Ventilation and the Common Cold

SUPERSTITIOUS beliefs as to the causation of disease occur with greater frequency in relation to the common cold than to almost any other type of disease. One hears much discussion of drafts, of moisture, or over-exercise, of wrong diet. As a corollary everyone has a favorite remedy which he believes is of value Almost all observers, including many physicians, overlook the fact that the disease is apparently self-limited and in the large majority of instances tends to get well without any medical treatment, except rest and proper control of the bowels. There are times when the disease seems to spread more rapidly than at others, when more persons are affected, and when some persons are affected more seriously. Furthermore, there are persons who rarely have colds, whereas others seem to succumb eight or ten times a year.

Extensive investigations have been made in many of the universities of the country to find out whether or not some of the common factors usually referred to are actively concerned in the causation of colds. Dr D. J Smiley of Cornell University studied such factors as over-exercise, cold baths, loss of sleep, drafts, kind of underwear worn, kind of shoes worn in wet weather, perspiration after exercise, constipation, mouth breathing, removal of the tonsils and adenoids, and heredity. He was compelled to conclude that not one of these factors could be considered the actual major factor in the causation of disease.

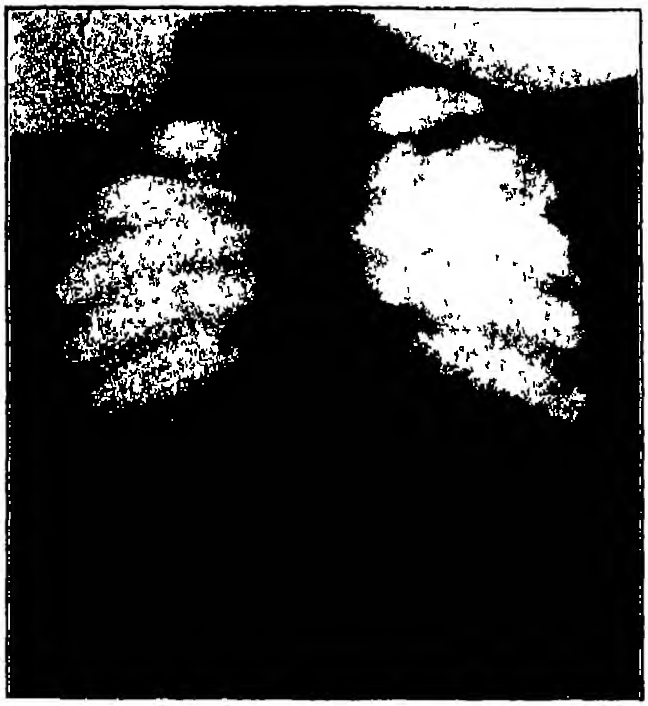
Now Dr. William H. Barrow of the Stanford University supports similar investigations with particular reference to the matter of climate. He found that the extremes of climatic conditions experienced in Massachusetts and New York State as compared with the more temperate climate of California is not a factor of major importance in catching cold. The various systems of heat used, such as coal or wood stoves, steam heat, hot air, gas heat, oil stoves, or no heat at all, did not seem to influence in any way the numbers of colds. He also found that it made little difference whether the students slept on a sleeping porch, a well ventilated bedroom, or a poorly ventilated bedroom. He found, finally, that persons who came to California from other climates had just about as many colds in California as when they were at home.

The evidence would seem to point more and more to the belief that the cold is caused by some definite bacterial organism which grows best in the bodies of certain persons, who provide it with what might be called an optimal soil. This soil is obviously a matter of the ability of the person to resist disease through placing his body in the best possible physical condition.

Foreign Bodies in the Lungs

NOT infrequently babies, or even some adults, inhale metallic substances, buttons, teeth, or similar objects into the lungs and, having no immediate severe symptoms, continue to carry these bodies about until changes occur in the tissues with serious results. Dr. W F. Manges of Philadelphia has recently analyzed instances of this kind which have come to medical attention. In one instance, a child inhaled a screw which it had in its mouth, and which blocked one of the main passages into the lungs for a period of one year and nine months before the mother undertook to secure medical consultation As a result of the presence of the screw in the main passage to the lung, the tissue became inflamed, the heart became displaced, and yet when removal was accomplished the tissues returned to normal. Of course, the passage was not completely blocked, or there would have been a serious destruction of the lung tissue.

In other instances, tacks, staples, nails, collar buttons, shawel pins, beauty pins, pencil caps and pieces of bone have been inhaled and kept in the lungs for a considerable time In the most severe case, a child inhaled some coffee beans which were kept in the lungs for 32 years In every instance in which a study was made, it was found that the presence of a foreign body in the lungs causes the formation of exudate or pus, with a thickening of the lung tissue and some bleeding Frequently the symptoms resemble those of tuberculosis, and medical attention is first called with that diagnosis in view When the foreign body is extracted from the lung, the patient usually recovers promptly



PIN LODGED IN CHILD'S LUNG

The pin was swallowed when the child was three years old. It was located 18 years later, by means of X rays

The Parathyroid Hormone

AMONG the most interesting glands in the human body are the parathyroid glands, lying behind the larger thyroid gland in the throat, the latter being closely associated with the disease known as goiter A few years ago, Dr J M Collip, who as a physiologic chemist, aided Drs. Banting, Best and MacLeod in the isolation of insulin, began a series of investigations which have led finally to the preparation of a stable and standardizable extract which contains the active principle of the parathyroid glands. The work is so new that the exact value of the material in the treatment of disease has not been definitely determined On the other hand, it may reasonably be predicted that it will have a real value in any condition in which the secretion of the parathyroid glands is deficient

Sometimes, following an operation, the patient develops tetanic movements or convulsions which seem to be definitely associated with a lack of parathyroid secretion In a few cases, the giving of the new parathyroid hormone seems to have had a specific effect leading to recovery There are also spasmodic conditions of infancy which seem to be associated with a similar deficiency, and specialists in diseases of children are already reporting cases in which the giving of the new preparation seems to yield excellent results

Through experiments made in laboratories of physiology, it has been shown that the parathyroid glands are definitely associated with the manner in which the body uses calcium and phosphorus. When the parathyroid glands are removed, there is usually a lowered amount of calcium in the blood and an increase in the amount of phosphorus When the new extract is given to dogs whose parathyroid glands have been removed, the amount of calcium in the blood rises and the amount of phosphorus, if increased, decreases. There are, of course, several human diseases in which the amount of calcium in the blood is deficient Among these are postoperative tetany, spasmodic conditions of infancy, tropical sprue, and some forms of inflammation of the kidneys

It is logical to believe that the new preparation may have virtues in the treatment of these conditions Such reports as are already available indicate that the parathyroid extract constitutes a valuable addition to the medical armamentarium

Hearing Through the Skin

PROF ROBERT H GAULT of the department of psychology of Northwestern University recently reported the results of experiments made under the auspices of the National Research Council to determine the extent to which a fingertip might be made to do the work of the ear Persons found to be totally deaf as studied with modern sound producing devices, were the subjects of the experiment It was recognized that what a person says is made up of a combination of rhythm, accent, emphasis, and varying tempo of sound, and of moving lips, facial expression and gestures Prof Gault points out that the deaf who are able to comprehend by lip reading lose certain characteristics of speech It seems possible that these may be supplied to some extent through the skin

In his experiments, Prof Gault used an electromagnetic receiver and a transmitter The receiver is held in the hand An amplifier is in circuit between the transmitter and the receiver All vibrations within the system are amplified approximately 175 times When the tip of the finger of the listener rests lightly against the diaphragm and someone speaks into the transmitter, the listener feels the vibrations of the diaphragm Prof Gault found by this method that trained listeners were able to sense by the feeling of the diaphragm the sounds of speech, and that they could learn to identify various vowels and diphthongal qualities

Eclipsing Variables

Stars Which Revolve in Pairs, Somewhat Like Dumbbells, Alternately Eclipse One Another. Recent Studies of Such a Pair Strikingly Confirm the Previous Theories of Astronomers Concerning the Several Characteristics of the Stars

By Henry Norris Russell, Ph.D.
Professor of Astronomy Princeton University
Research Associate of the Mt Wilson Observatory of the Carnegie Institution

SCIENTIFIC activity varies to a remarkable degree from one country to another In some nations, although material resources are great and education widespread the advancement of knowledge is relatively small, in others it is unstable To attempt to list the names at the lower end of the list would be a thankless task, and to award the highest place would be a delicate matter But there can be no doubt at all that a very high place—close to the top, if not actually there—belongs to Holland

The population of the Netherlands is not great, but the scientific work that comes steadily from that small country is remarkable, both for its amount and its quality This is true in many fields—physics and biology, for example—and it is true also of our chosen topic of astronomy

The Dutch observatories, a few years ago, realizing the desirability of cooperation, joined in the publication of the *Bulletin of the Astronomical Institute of the Netherlands* and this journal, from its first issue, took a prominent place in the current literature of the science Many branches of investigation are included among the researches which it publishes, and perhaps the prettiest bit of work which can be found in all the accumulated literature of last summer is among them

An Eclipse Every Nine Hours

This report comes from Leyden, and from the pen of one of the younger members of the observatory staff, Dr van Gest, who has been engaged in the measurement of starlight by photography

The photometric observer is always on the lookout for promising objects to observe Stars which vary in brightness are his delight, and if he has any love of theory, he welcomes most of all a case in which he cannot only make observations, but interpret them

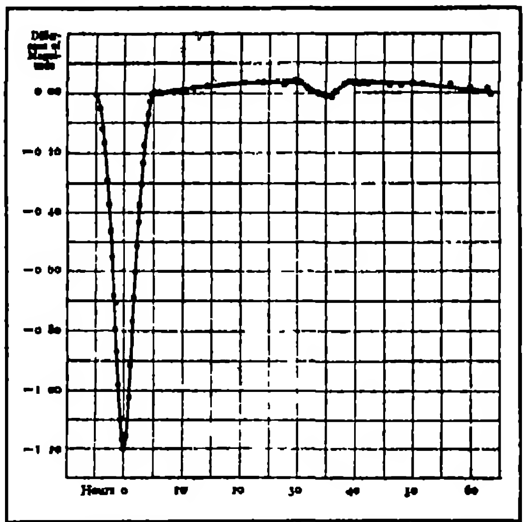
Eclipsing variables—in which a pair of stars, revolving about their common center of gravity, alternately eclipse one another—give such an observer a fine chance, for he can find out from his observed "light curve" a great deal about the size, brightness and density of the two stars Such systems are often discovered casually -in the course of a general examination of all the stars on a set of plates in order to pick up any that may change in brightness Sometimes, however, they may be deliberately sought—the observer taking a star which is known to be double anyhow, by spectroscopic observations, and measuring its light to see whether eclipses occur.

Sometimes his labor is in vain, the orbits of the pair are tipped at such an angle that they pass clear of one another, and no eclipse happens, but, when the observer uses good judgment in making his working list, he very frequently meets with success

Dr van Gest—guided by the very competent advice of Professor Hertzsprung—has worked upon an apparently insignificant star, which turns out to be of exceptional interest

The bright star Castor (Alpha Geminorum) is known to all observers as one of the finest doubles in the sky The two brilliant stars, some five seconds of arc apart, can be separated with a small telescope The observations of the last two centuries show that they are in slow orbital motion, with a periodic time of three or four hundred years But this is not all More than a minute of arc away is a faint star of the ninth magnitude—less than 1/600 part as bright as the leading component of the pair —which is moving in space along with the other two, and shows evidence of a very slow orbital motion—revolving about the bright pair in a period which must be many thousands of years in length

The spectroscope shows rapid changes in velocity in all three of these stars, proving that each of them is a very close double—far too close to be separated by any telescope which is ever at all likely to be built This is due to the rigid limitations set by the consideration of resolving power



From Fath's Elements of Astronomy Copyright McGraw Hill Co Inc Light curve of Algol, according to Stebbins

BEHAVIOR OF A TYPICAL ECLIPSING VARIABLE

As an example of this type Algol's brightness remains almost uniform for over two days then in five hours it decreases markedly, but recovers its former brightness in five hours more

For the brightest star, the period is about nine days, for the other conspicuous one, just less than three days In both cases the companions are too faint to be detected—their light is drowned out by the glare of their primaries But this does not mean that they are "dark stars"

The parallax of Castor has been very carefully measured, and its distance is known to be 45 light years (with an uncertainty of perhaps 10 percent) It follows that the brighter star is 24 times and the fainter one 11 times as luminous as the sun, so that the "dark" companions might each be a good deal brighter than the sun itself and yet be hopelessly lost to observation The distant component, however, is a really faint star, giving off only 1/30 of the sun's light The spectroscopic observations (made at Mount Wilson by Adams and Joy) show that it is composed of two stars of equal brightness, revolving on the very short period of 19 hours 32 minutes, but with the high velocity of 230 kilometers per second

It is this faint star which Dr. van Gest has photographed, and he finds that eclipses actually occur in which the light of the system is reduced by 40 percent. The two close components alternately eclipse one another partially at intervals of 9 hours and 46 minutes.

The eclipses last only a little over two hours, showing that the stars are fairly small, in comparison to the interval between them—the diameter of each being not quite one-third of the distance between their centers—assuming, as must be nearly true, that they are of the same size.

The spectroscopic observations give the scale of miles of the system, and show that the components are 1,600,000 miles apart, and that each is 520,000 miles in diameter—three-fifths as big as the sun This is the smallest size so far found by direct observation for any star.

From the distance and period, it is found that each star has 52 percent of the sun's mass—from which it follows that their mean density is 2½ times the sun's, or 3½ times that of water. This is again noteworthy, being far greater than for any star previously studied in this fashion—although, of course, nothing at all when compared with the Companion of Sirius.

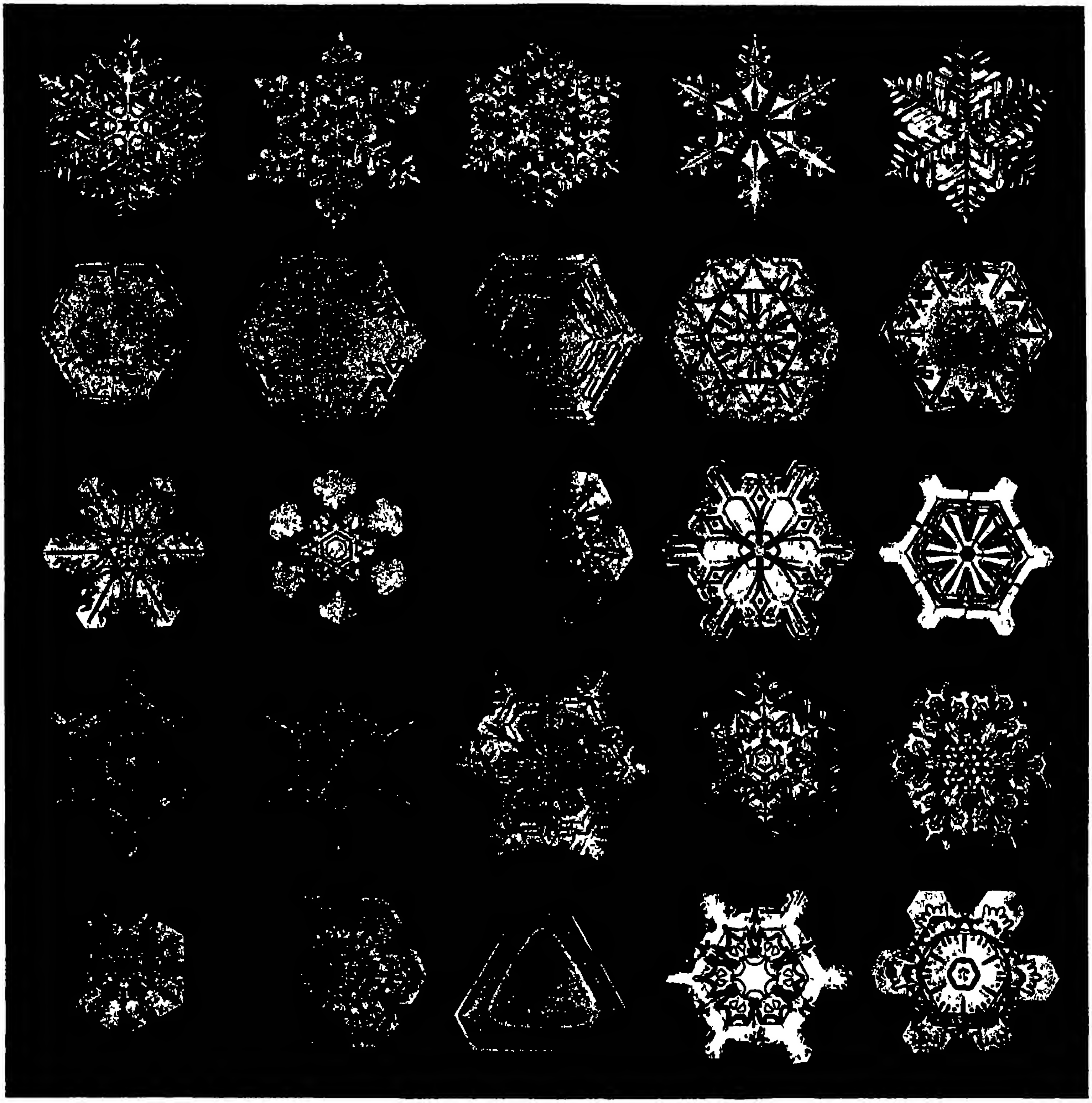
The Best Known Star of All

But still more remains The distance and real brightness of the system are known Each component gives out 1/60 as much light as the sun, from a superficial area which is 36 percent of the sun's. It follows that the amount of light emitted per square mile of surface from these stars is only 1/21 as much as from the sun. This shows that they cannot be nearly as hot as the sun, and calculation from the laws of radiation indicates a surface temperature of 3,500 degrees, Centigrade This is in perfect agreement with the spectrum, which is of Class M, typical of the red stars of low temperature

Putting all these things together, it may fairly be said that we now know more about this little star than of any other Distance, brightness, size, mass, density, color, temperature—all are known. They are known pretty accurately too—or they soon will be when a little more work has been done on the spectroscopic orbit The star is a typical red dwarf, rather brighter, and probably a little bigger, more massive, and hotter than most dwarfs of Class M, but a good sample, just the same

It is a striking evidence of the advance of our knowledge that all its properties now appear entirely normal—agreeing closely with those which might have been predicted from our general knowledge concerning the stars But the direct confirmation of these predictions, by clear and positive evidence in a typical case, is of great value to all who are interested in astronomy

One more remark should not be omitted Dr. van Gest observed with a rather small telescope—13 inches in aperture—and, on this plate, the image of the faint star was only 1/12 of an inch from that of the far brighter pair To obtain these good measures under such difficulties deserves special praise.



Marvelous Crystal Structures From Cloudland

It was the presentation of a microscope by his mother while he was in his mid teens, that prompted W. A. Bentley to commence the study of snow crystals. With this instrument he first observed the beautiful forms that these crystals often take, and with boyish enthusiasm he attempted to sketch them. This method did not prove satisfactory and soon a photomicrographic system was tried. After many failures, success was attained and from that day forward, Mr. Bentley has been pursuing his interesting hobby, not for financial gain but for the pure love of the subject. Besides a microscope capable of magnifications of from 8 to 60 diameters and an extension camera coupled to it, other accessories were found necessary. These included an observation microscope, glass slips, a black board on which the crystals were to be caught, a pointed wooden splint to pick up the crystals, a duster for removing undesirable specimens and a feather to press the crystals flat on the glass slides. In actual practice the crystals were caught on the board and taken to the cold room indoors where the apparatus was located. They were then viewed briefly with the observation microscope and if of sufficient individuality they were pressed flat on a glass slide and photographed. After several years of snow crystal study some interesting data was collected. In the location that happened to be chosen, Vermont, the crystals collected during storms when the snow fell from the western quadrant were found to be best. The most favorable snowfalls were found to occur during or at the end of a cold snap attended with below-zero weather. Photographing was found to be possible at temperatures of from 20 degrees, Fahrenheit, downwards, and some of the results are shown in the photographs reproduced on this page. After years of work it was found that the first location, chosen by chance, was the best of many subsequently tried. Crystals of the same fine symmetry and in fairly large quantities could not be found elsewhere.

Our Point of View

The "Human Interest" Reporter

It is amazing that in this age of scientific and technical advancement, and in view of the wide and ever-growing public interest in science, the editors of our daily papers should send reporters to write up great disasters such as the Florida hurricane, who apparently are more interested in getting out a sensational story than in bringing to light engineering lessons which lie hidden in every great physical disaster of this kind. In the first place, these scribes seems to be afflicted with a disease which for want of a better term, we may call "superlativitis" As a result, the figures of death and destruction are invariably multiplied some three or four times, and instead of the public learning the really serious lessons taught by the Florida disaster, they are regaled with the old, old story of seas washing up over seawalls and boulevards, of flimsy frame houses overturned and "smashed into kindling wood," of trees blown down, and so forth and so on. The point is well made by the *Engineering News Record* when it says that, "a reporter in Miami on that awful Saturday would have considered his fortune made if he had found a mother cat caring for a brace of puppies under one of the overturned boats in Royal Palm Park"

It seems to us that every great daily paper should include in its staff a trained technical man whose special field should be the investigation of railway wrecks, shipping disasters, and structural failures involving serious loss of life and property. Our daily press surely does not wish to cater merely to that class of moron, which will sit unmoved through the scenes of a first-class moving picture and burst into uproarious applause only when the face of a player is plastered with a well aimed custard pie As noted elsewhere on this page, the wonderful resistance offered by the tall buildings of Miami to the fury of the hurricane, answered a question which millions of people today must have asked themselves many times. Yet, this outstanding fact was passed over practically unnoticed.

Pure Science Research in Europe

THE Secretary of the National Research Council, Dr Vernon Kellogg, on returning from several months abroad, states that we can no longer depend, as we have so largely done in the past, upon scientific research in Europe for future development. He thus emphasizes Secretary Hoover's recent call for the promotion of research in pure science in America. We are reminded that Germany, France and various other continental countries have for generations led the world in the study of pure science and that the United States has profited by the results But Europe has received a staggering set back in its pure science research work as a result of the stringent, economic conditions imposed since the World War Europe has little money for anything but pressing immediate necessities "Everywhere," says he, "I have met with the cry, 'We have little money for research, what are you in America going to do?'" We owe it to ourselves, nay, we owe it to the world at large, to turn a larger share of our enormous post-war wealth into the channels of pure science research

The Future Transatlantic Liner

RECENTLY in these columns, we stated it as our opinion that no ships of the size of the *Leviathan* or the *Majestic* would be built, at least in the near future—this for the reason that the big shipping companies state that these huge vessels do not pay. We have before us, however, an issue of one of the leading London technical papers which states that definite suggestions for the building of a large ocean-going liner are being put forward by one of the leading British ship-owning firms. There is proof of this in the fact that the Clyde Navigation Trustees are being asked whether, if such a ship were built on the Clyde, she could be safely launched and taken to the open seas. The largest ship thus far built on the Clyde is the *Aquitania*, which is just over 900 feet in length. It seems that a ship 1,000 feet long would have sufficient launching space, since the building ways are so placed that large vessels can pass into the mouth of the River Cart which empties into the Clyde, approximately opposite to the building yard. It is evident that the urge to build a 1,000-foot ship is due to the fact that travel to Europe is so large in the summer that during the past season all big liners have been filled to capacity Structurally, there is no reason why a ship of this, or even larger size, could not be built.

> ### Steel Buildings Survive Tornado
>
> **The outstanding engineering fact after the late Florida hurricane had done its worst was practically ignored by the reporters who were despatched by their respective editors to the desolated territory. We refer to the fact that, with one or two minor exceptions, the towering skeleton-steel business buildings of Miami passed unscathed, so far as their structural integrity was concerned, through the terrific ordeal. Tall office buildings, also, of which the steel frame only was completed, showed the same strength and stability. This is the more gratifying when we remember that a unit pressure of only 20 pounds per square foot was used in designing these buildings as against the 30 pounds per square foot used in designing steel bridges. One partial failure was in the case of a 16-story building which was only three rooms in width, and some fourteen rooms in depth. The bending stress across the narrow width of the building strained the columns beyond their elastic limit and bent the building so that the cornice is nearly two feet out of the perpendicular. Sufficient reinforcement at the connections of floor beams with columns would have saved the building.**

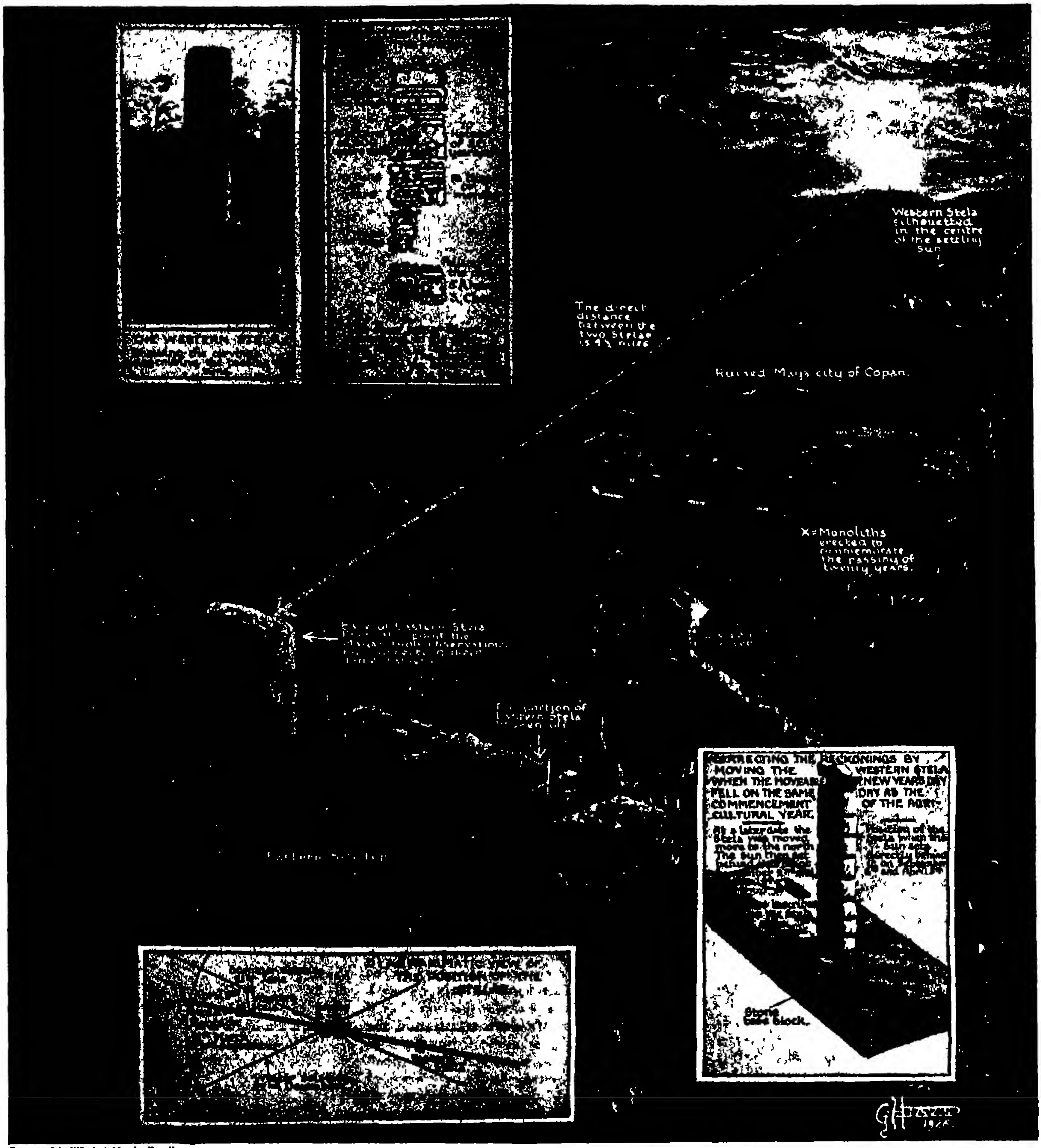
Filling In the East River

PERIODICALLY, we hear discussion of the problem of providing more building ground for New York by filling in the East River, and incidentally providing free intercommunication between New York and Long Island Proponents of this scheme have all overlooked the most important element of the problem. Always they have failed to make any suggestion as to where the enormous amount of material could be obtained to fill in a vast pit from three to four thousand feet wide, with depths reaching 60 and 70 feet, and extending for many miles. All the excavated material from new buildings in New York, if dumped into the river, would make but a small impression, and if the material were sought nearby—as it would have to be to keep down costs—it would be necessary to dig up no small part of the adjoining real estate of Long Island. The principal motive behind this suggestion is, of course, to provide adequate communication with Long Island, which, together with New Jersey, will have to house the teeming millions of this rapidly growing city. To our thinking, the largest relief would be obtained by building the great 59th Street bridge across the Hudson River and connecting it by means of an elevated boulevard across Manhattan Island with a new bridge across the East River near the present Queensboro Bridge, which is already frightfully congested. This would enable the very large traffic between Long Island and New Jersey to pass over Manhattan Island without adding to the congestion on its streets, and it would make the vast, unoccupied areas of New Jersey and Long Island easily accessible by rapid transit trains, trolley cars and automobiles. Construction of this work would ease the situation for many years to come.

Closing the East River would be opposed by the Navy, on the ground that it would shut out the Navy Yard from direct communication with Long Island Sound. The possession of two independent routes to the Atlantic is of great value Today, a blockading fleet would have to split its forces, placing one fleet at Sandy Hook and the other at Montauk Point. With the East River closed, it could concentrate at Sandy Hook.

Roller Bearings for Railroad Trains

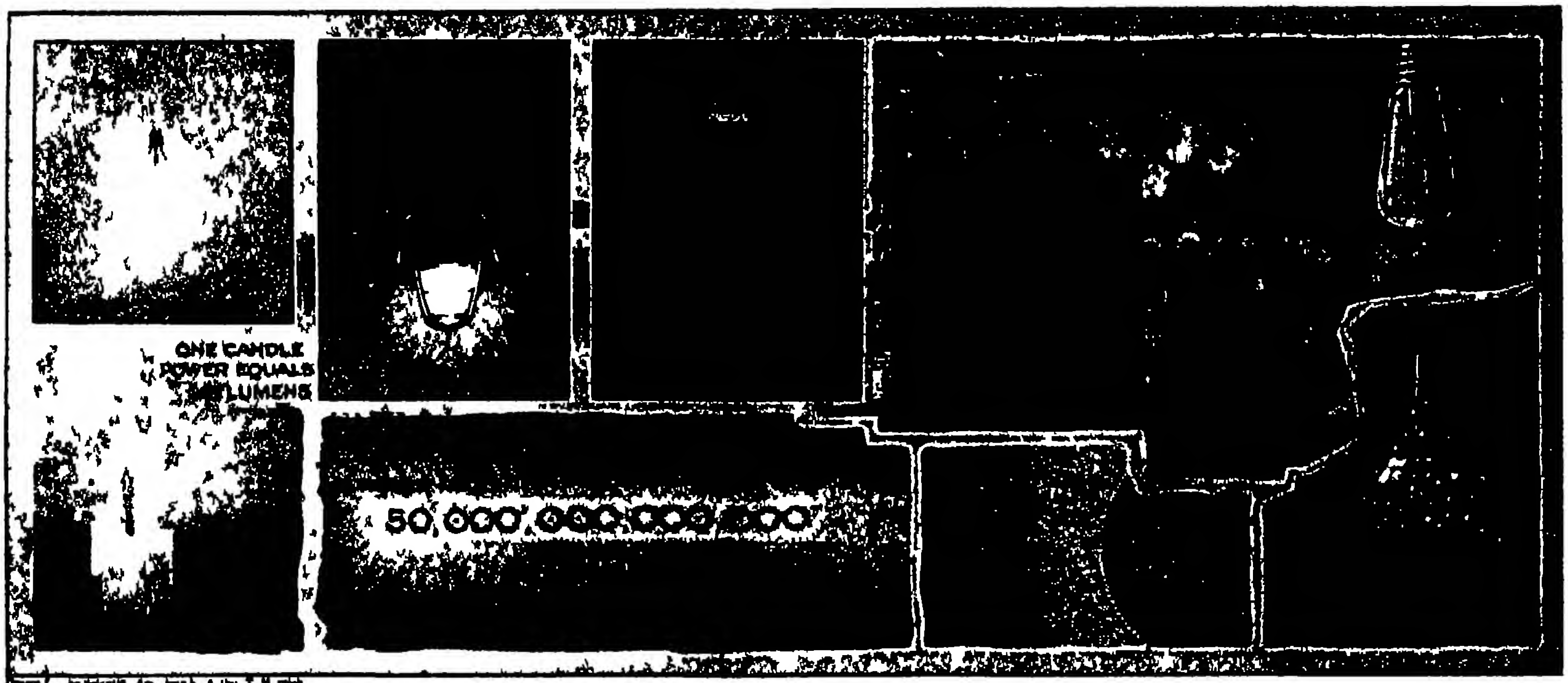
THE marvelous efficiency of the motor car is due in large part to its being equipped throughout with roller and other anti-friction bearings Before the advent of the motor car, far-sighted engineers had been trying to develop anti friction bearings for heavy passenger and freight cars. For lack of experience in the construction of such bearings, and because steel of the high quality necessary to endure the heavy unit stresses imposed was not available, these efforts met with little success. Today, however, the limitations of the roller bearing and the problems which have to be faced in its application to heavy axle loads are well understood, and it is gratifying to learn that one of the great transcontinental roads has successfully applied roller bearings to its through trains. The Chicago, Milwaukee and St. Paul Railway has announced that it is equipping its passenger trains with bearings of this type, which are being applied to a large number of new Pullmans and 64 of its own sleepers. This decision has been arrived at after two years of experimental work by this company, which announces that one of its standard test sleepers equipped with roller bearings has already traveled over 119,000 miles. The statement of results obtained in these tests is startling, for we are informed that a coach equipped with these bearings required 7 59 pounds of tractive effort per ton to start it, whereas another coach, with well-worn friction bearings of the standard type, required 54.4 pounds of tractive effort per ton —the total effort in starting being relatively 500 pounds as against 3,600 pounds per coach. The most valuable gain for the passenger is the absence of that surging and shock which is such an obnoxious feature of travel. After the train has started, the difference between the frictional retardation of the two types of bearing diminishes.



Courtesy of the "Illustrated London News"

The Largest Sundial in the World

How the civilized Mayas kept accurate track of time was recently explained by Dr Thomas Gann who has just conducted an archeological expedition in Middle America. At Copan, one of the oldest cities of the Maya Old Empire which flourished from about 100 B C to 500 A D, two stone stelae or monuments (connected by the dotted line, above) have been discovered These, according to Dr. H. J Spinden of Harvard, form a gigantic sundial four and one half miles across Here "the sun, as viewed from the eastern stela, set behind the western stela every year upon a date which the Maya regarded as the beginning of their agricultural year The most remarkable discovery,' continues Dr Gann in the *Illustrated London News*, "was the fact that the base of the eastern stela is *on an exact level* with the base of the western" "O Pop" was the Maya New Year, but their year contained only 365 days, with no Leap Year Due to this, "O Pop," originally April 5, gradually fell behind an entire year



SOME SOURCES OF LIGHT AND THEIR RELATIVE EFFICIENCIES

In the accompanying article Professor Harvey draws some interesting comparisons. Several of these are graphically illustrated above, and a comparison of these drawings with the text will be of assistance in comprehending the subject

Luminous Bacteria, the Smallest Lamps in the World

The Characteristics and Efficiency of a Lighting Plant of Twenty Quadrillionths of a Candle Power

By E. Newton Harvey, Ph.D.

Professor of Physiology, Princeton University

IN the National Academy of Sciences building in Washington is a tiny incandescent bulb the size of a grain of wheat, a lamp one quarter inch long, which can be inserted in small cavities of the body for illumination during the performance of delicate surgical operations. If this were connected with a dry cell we should have a complete man made illuminating system. Small though the lamp is, its structure is easily visible to a keen pair of eyes. No microscope is necessary to take it to pieces and measure its various parts. This is true of all our machines, whether they produce light or heat or electricity.

Living things also produce light, heat and electric currents, but the mechanisms involved are far more intricate. An engineer with his powerful wrench can easily unscrew the nuts of a dynamo. With what tools are we to examine the lighting device of a firefly? Yet a firefly is one thousand times as large as some of the small creatures of the sea which give rise to the phosphorescence observed in the wake of a boat or on the ruffled surface when disturbed by the wind or oars. The best known of these forms is called *Noctiluca*, but there are many different kinds capable of lighting. They flash when touched or stimulated in any way. There is a mechanism for turning the light on and off.

In this respect they differ from still smaller creatures, the luminous bacteria, Figure 1. These also live in the ocean but they do not contribute to the phosphorescence of the sea under ordinary circumstances. They are so small that the light from a single one cannot be seen with the eye or with the microscope. It takes many thousands together to produce enough light to affect the retina. An individual of average size is a short cylinder with rounded ends measuring 1.1 by 2.2 μ.* The volume is about one 1,700,000,000th of a cubic millimeter. It would take 40 million of them to fill a *Noctiluca* and 40 quadrillion to fill a man. If one of these creatures were enlarged to the size of a grain of wheat lamp, it would be over four billion times its actual size.

Imagine the difficulties of exploring the structure of such a machine as this. And yet we do know something about the light production of these tiny organisms, for they may be treated in bulk as averages, just as we treat atoms and molecules. Quite a good deal is known about the structure of atoms and molecules. Light production by bacteria is chemical in nature and so our tools are the test tube and the measuring glass.

> **Man Imitates Nature**
>
> **Who has not read loose statements that the firefly or other luminous forms of life generate light far more efficiently than man does in his power plants? Granting that the overall efficiency of the best incandescent lamp is only ⅓ of 1 percent, parallel calculations on "cold light" forms of life demonstrate that the overall efficiency of some forms, such as luminous bacteria, is only twice as great. Thus, we are within hailing distance of Nature already. So man, who occasionally likes to belittle his own achievements, has not done so badly after all. Probably he can do better. —*The Editor***

Although luminous bacteria occur in the sea it is only when they grow in great numbers on some nutrient material like a dead fish that we observe their light. Then the whole fish shines in the dark, Figure 2. These glowing fish were known to Aristotle and Robert Boyle, inventor of the air pump, studied them in 1667. He showed, in fact, that under the receiver of his air pump the light disappeared, to return again when air was readmitted. Thus he demonstrated the necessity of oxygen for luminescence, although the word oxygen was not used at that time. Boyle had a keen insight into the meaning of his experiment, for he goes on to draw a comparison between a glowing coal and the glowing fish, both of which require air for the light. Both are combustions, but in luminous animals the combustion produces a very large amount of light in proportion to the heat produced. The temperature in some luminous animals during luminescence does not rise one thousandth of a degree. It is "cold light" indeed.

Luminous bacteria, unlike some other forms, are quite harmless. They are the first bacteria to appear on fish or meat and only later are they crowded out by putrefactive varieties. They can easily be grown on ordinary culture media containing the right nutrient material, Figure 3, top. A flask inoculated with *Photobacterium phosphorescens* will glow like a ball of fire, and small individual colonies of bacteria scattered over the medium look like the starry sky. I have grown these bacteria in large pie plates and scraped off the organisms into sea water, where they form a cold greenish colored liquid fire.

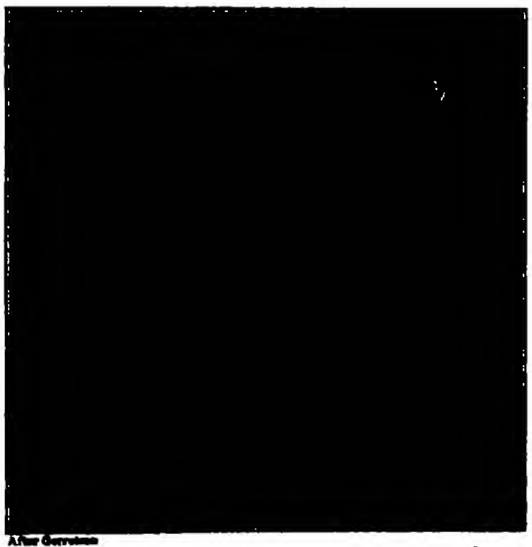
A dense emulsion of bacteria in sea water uses up oxygen so rapidly that it must be continually shaken to dissolve more oxygen, otherwise the light will go out, remaining visible only at the surface where the bacteria are in contact with air. These bacteria can be used to detect oxygen, and so delicate are they that one part of oxygen in 143,000 parts (by volume) of inert gas will produce a luminescence visible to the naked eye.

* 1μ = .001 millimeter = about one twenty five thousandth inch

Sometimes luminous bacteria find a place to grow on living animals. The animal may be unharmed and live for days, or it may be injured and finally die. This is the case in a malady of sand fleas sometimes observed along our coasts. The sand-fleas finally die, but while infected they are able to move like normal individuals, although as they jump about in the sea weed they are brightly luminous from the bacterial infection. If we did not know the origin of the light we might consider them self-luminous animals. The malady can be passed from one animal to another by inoculation. In fact it is quite possible to inject pure cultures of luminous bacteria into fish, squid, frogs, or other forms and make them luminous. The animal usually overcomes the infection but sometimes the bacteria live until they overcome their victim.

In a few instances animals are known which always contain luminous bacteria. A well authenticated case is that of two luminous fishes found in the Dutch East Indies, in the Banda Sea, which have developed a luminous organ designed for the support of luminous bacteria. Figure 4. The organ is large, just under the eye, and the bacteria are of a special kind which will not grow on ordinary culture media or on the outside of the fish. They are spoken of as "symbiotic luminous bacteria" and they present only another case of a mutual benefit partnership between two different organisms.

The fish have the benefit of the light while the bacteria are supplied with free board and lodging. Figure 5. A very rich system of blood capillaries brings food and oxygen so necessary for the luminescence of these bacteria. As it is characteristic of luminous bacteria that their light is shining day and night continually as long as they are alive, these fish have had to develop a screen to cut off the light, so we find a fold of black pigmented skin, like an eyelid, that can be drawn up over the luminous organ to observe the luminescence. Hence the name of the fish, *Photoblepharon*, or "light eyelid." The fishermen of Banda cut off these luminous organs, remove the screen, and impale them on hooks for bait. The light will shine steadily for a night's fishing. But *Photoblepharon* itself swims about in the sea, turning its great luminous organs on and off like many another fish that manufactures its own light material without relying on the kind assistance of luminous bacteria. Only a careful microscopic examination reveals the true nature of the luminescence of *Photoblepharon*.



After [illegible]

LUMINOUS BACTERIA, *PHOTOBACTERIUM JAVANENSE*

FIGURE 1: *Highly magnified. This is a different kind from that used by the author*

Luminous bacteria prefer a low temperature for growth and are sometimes found growing in refrigerators. They can live on meat or eggs or almost any material which is not markedly acid. Robert Boyle records no ill effects from eating meat brightly luminous with (as we now know) luminous bacteria.

PROFESSOR E. NEWTON HARVEY

Professor Harvey's researches include not only those on light production by animals but on the permeability of cells, rate of nerve impulse, and oxidation

It will thus be seen that luminous bacteria are quite ubiquitous. It is not surprising to find them connected with man himself. Before the days of aseptic and antiseptic surgery, wounds frequently became infected with luminous bacteria and glowed at night. The surgeons of that time believed that luminous wounds were more apt to heal properly than non-luminous ones. Perhaps there is some truth in this view. Since luminous bacteria are harmless non-pathogenic forms, it is possible that such forms might crowd out pathogenic bacteria which were striving to gain the ascendency on the wound.

How Efficient Is Cold Light?

In the older literature there is a case of luminous sweat and several cases of human urine, luminous when voided, are reported. If these observations are really true—and so far as I know they have not been confirmed in recent times—we may be dealing with luminous bacteria. Or there may be secreted some easily oxidizable substance that luminesces during its oxidation. Several such bodies are known in organic chemistry.

Luminous bacteria grow so easily in the laboratory that they are excellent forms for study, although not the best forms for certain phases of the subject. Thus, it has been shown that in some luminous animals two substances, in addition to water and oxygen, are necessary for luminescence—a discovery due to the French physiologist, Dubois, in 1887. He found that a luminous extract of an animal could be separated into two parts, one containing luciferin, which will oxidize with the production of light, and the other part containing a catalyst or enzyme which accelerates the oxidation of luciferin. The two substances could be separated by a difference in their properties, luciferase being destroyed on heating, while luciferin was not. We can obtain the two substances in solution in water, and they can be precipitated by various reagents. They can be purified and experimented with like any other bodies, although we do not know what is their exact structure. Chemically, luciferin is probably to be placed among the proteins, among the simplest members of the proteins, the peptones or proteoses; and luciferase is related to the albumins.

The presence of luciferin and luciferase cannot be demonstrated in luminous bacteria, although it is very likely that they exist and experimental difficulties prevent their demonstration. We are surely justified in speaking of the oxidizable photogenic material in the bacteria as luciferin and we may now ask how economical a process this oxidation of luciferin is. What is the efficiency of a luminous organism, regarded as a light producing machine?

First it must be fully understood what is meant by efficiency in the case of illuminants. When an incandescent electric lamp lights, coal is being burned in some power house. Some energy is lost in generation of current, as only about 20 percent of the energy of the coal appears as electric energy at the lamp terminals. In the lamp, electric energy is converted into total radiant energy of all wavelengths (infra red or heat, visible or light, and ultra violet or chemical radiation) and this transformation may be very efficient in the case of a tungsten nitrogen filled lamp, about 95 percent. But the most wasteful transformation comes when we consider the proportion of visible radiation in the total radiation. The visible radiation is only three percent of the total radiation, and 97 percent is waste heat of no value for seeing things.

The "overall" efficiency is the product of all these efficiencies and represents the percent of energy in the coal which appears as visible light. For the best incandescent lamp it is about one half of one percent.

The energy of the coal is measured by the number of calories of heat produced when the coal is burned. As a pound of coal in burning uses up a very definite amount of oxygen, producing a definite amount of heat, we could calculate the energy of the coal in calories by measuring the oxygen it consumed in burning. Visible light or luminous radiation can also be expressed in calories.

After [illegible]

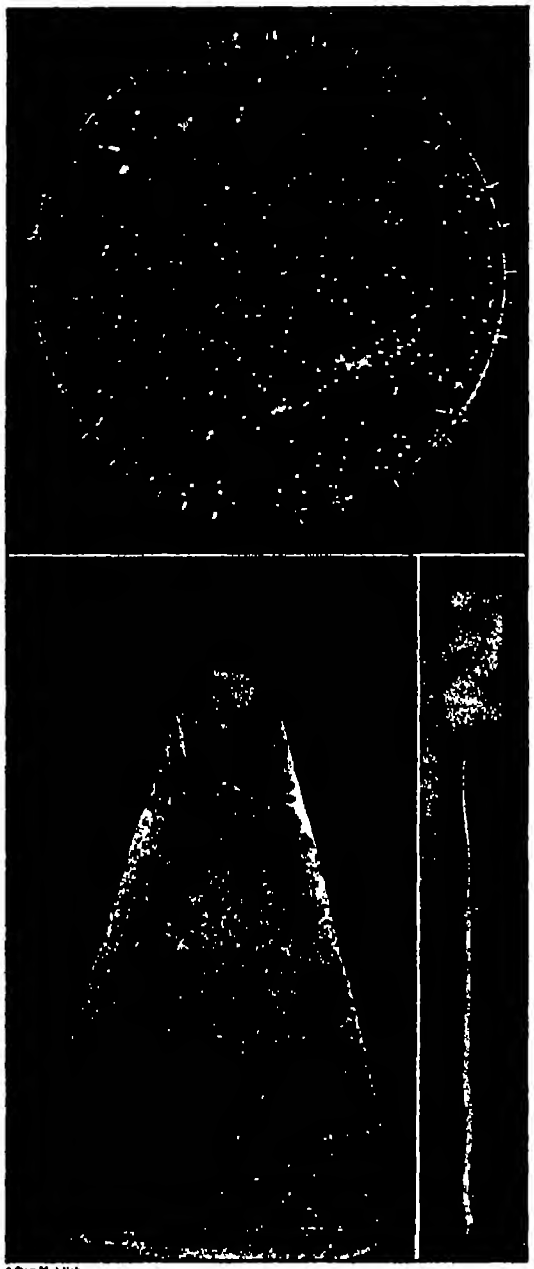
LUMINOUS BACTERIA ON DEAD FISH

FIGURE 2. *The whole fish shines in the dark. Placed in a vacuum (no oxygen) the glow ceases*

Let us now apply these facts to luminous animals, regarded as power plants for illumination. We must ask what fraction of the energy of the fuel (food) appears as light. No one has determined this for the firefly, and the investigation would present special difficulties because the firefly flashes, and flashing lights cannot be measured easily. We are forced to fall back on luminous bacteria which emit a steady light, despite the fact that they are the smallest luminescent creatures.

The percent of visible radiation in the total radiation of the firefly has been measured and is practically 100 percent since no infra red or ultra violet light is produced. The same would be true of luminous bacteria. On this fact is based the general statement that luminous animals are so efficient and economical. The statement refers only to their *luminous* efficiency and not to their efficiency as radiation producers. What we wish to know is the "overall" efficiency of the bacteria.

To obtain this we must measure the light produced by a single bacterium, and express this in calories per second. Food represents the source of



After Molisch

MORE LUMINOUS BACTERIA

FIGURE 3 TOP *Growing on a culture medium* BOTTOM *In a flask or a test tube they glow like fire The specks of light are each great numbers of bacteria*

an organism's energy, the energy input, and when burned, liberates a maximum amount of energy, which is also measured in calories We must measure the food utilized by the bacterium and express the energy input in calories per second Then, light emitted in calories divided by food oxidized in calories, gives us the overall efficiency of a bacterium.

The light measurements themselves present no particular difficulties. We can make an emulsion of luminous bacteria in sea-water, many billions of them, count the number of bacteria per cubic centimeter, measure the amount of light emitted by one cubic centimeter, measure the absorption of light by bacteria in front of others, and calculate the amount of light in "lumens" which each bacterium would emit in all directions, provided there were no absorption As one candle emits four π lumens, the candle power of the smallest light in the world is easily obtained It is about 20 quadrillionths of a candle for a luminous bacterium

Just as we can measure the energy of coal by the oxygen it consumes in burning, so we can measure the energy of an animal's food, for instance sugar, from the total oxygen it consumes in burning the food This is because of the equation:

$C_6H_{12}O_6 + 6O_2 = 6CO_2 + 6H_2O + 677{,}200$ gram-calories.

Interpreted this means that a molecular weight in grams (180 grams) of sugar combine with six molecular weights in grams (192 grams) of oxygen to give a definite amount of carbon dioxide and water, with the liberation of 677,200 gram-calories of heat. One gram of oxygen burning sugar therefore represents the energy of 3,527 gram-calories.

Metabolism experiments in animals have actually shown that for a gram of oxygen consumed a certain number of calories is produced by oxidation of the foodstuffs, depending on the kind of food. A gram of tallow oxidized by a guinea-pig liberates the same amount of heat during combustion to CO_2 (carbon dioxide) and H_2O, as if it had been burned in a candle. This was one of Lavoisier's great contributions to science. A bacterium could obtain no more energy in burning its foodstuffs than a guinea-pig or any other organism

Knowing the oxygen consumption of an animal and its food, we can calculate its heat production, and this "Method of Indirect Calorimetry" gives results which are in surprising agreement with direct measurement of heat production in a calorimeter Applying this method to luminous bacteria, which were fed upon 60 percent glycerine and 40 percent peptone, we can calculate that each gram of oxygen consumed should produce 3,400 gram-calories or 3 4 gram-calories per milligram of oxygen consumed In order to find how much energy is supplied by the food during luminescence, we have only to measure the oxygen consumed by the bacteria.

Can Man Outdo Nature?

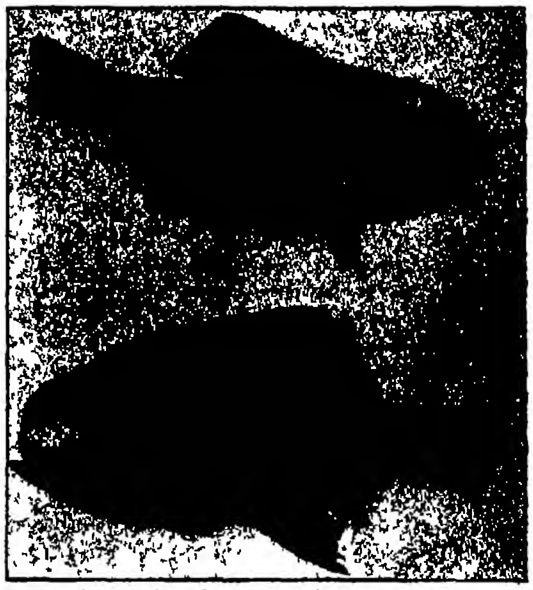
Converting energy from milligrams of oxygen utilized and lumens of light emitted into the same units—calories—the overall efficiency of a bacterium turns out to be 0 16 percent This tells us the percentage of the energy necessary to run a bacterium, which appears as light. It does not give us a true picture of the efficiency of the light-producing reaction, for much of the oxygen consumed is used by bacteria for growth processes which have nothing to do with luminescence

To continue our comparison of a bacterium with a power plant, it is as if the power plant had to enlarge itself at the same time that it generated electricity The power plant is a stable unit, and in the comparing of a bacterium and a power plant it is hardly fair to count the energy used in growth as part of that necessary for light production Unfortunately we do not know what percent of the oxygen consumed by a bacterium is used in growth or other processes It can be shown by other experiments that certainly only one sixth of the oxygen is used in luminescence, and probably very much less than this. Using the figure, one sixth, brings the efficiency of the bacterium to nearly one percent (16 percent × 6), a figure twice as great as that for overall efficiency of the best incandescent lamp

Thus, even the smallest creatures can very efficiently carry out the most complicated processes We can imagine the oxygen going in and can see the light coming out of a bacterium, the alpha and omega of luminescence.

What a marvelous spectacle the intermediary mechanism must present!

Magnify a bacterium ten million diameters. It would be 22 meters (about 75 feet) long. Oxygen and water molecules would be three or four millimeters in diameter. We should see the atoms in all their complicated movements and positions. We should see how the outer surface of the bacterium acts as a selective membrane, letting some molecules through and keeping others back. We might feel the oxygen molecules rushing in, 215,000 of them entering every second by actual count. Or we might feel carbon dioxide molecules rushing out, even more of them, the great vital wind of respiration, common to all living things. Inside would be catalytic surfaces, their molecules arranged in a definite way, changing and yet unchanged. For modern ideas of molecular structure are not mere



PHOTOBLEPHARON, BANDA ISLANDS

FIGURE 4· *Its luminous organ contains symbiotic luminous bacteria The organ shows, on the lower fish, as a white, oval mass under the eye In the upper fish it is concealed by a fold of pigmented skin, like an eyelid*

figments of the imagination but represent something real. The molecules of a film of oil on water are known to stand side by side, their feet entangled in, their heads above the water.

If our time sense were properly altered, we might observe the light emitted in pulses or quanta, 1,280 from each bacterium every second, by actual measurement. If, as the measurements indicate, 215,000 molecules of oxygen are absorbed and 1,280 quanta emitted every second, it would take 168 oxygen molecules to produce a quantum of light. If so we should be justified in saying that only 1/168 of the oxygen absorbed was used in luminescence. This would make the overall efficiency of a bacterium very high indeed, perhaps 25 percent.

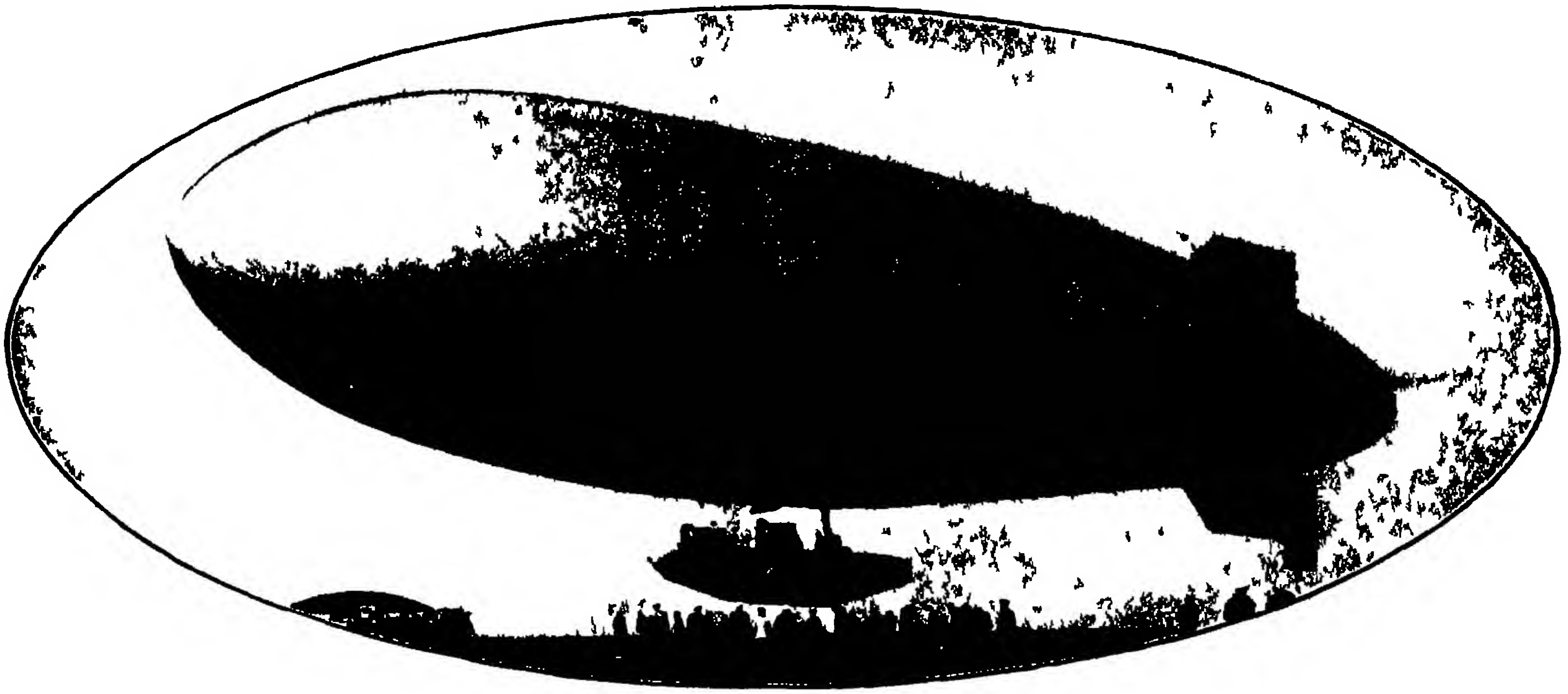
Here is a line of inquiry for future study, that involves research of fascinating interest and which may lead to matters of great practical importance.

After Steche

SECTION OF THE LUMINOUS ORGAN SHOWN IN FIGURE 4

FIGURE 5 *This shows the tubes of nutrient material which contain the luminous bacteria. These organs are used for bait in Banda (Dutch East Indies) by the fisherman, as they will continue to shine for a whole night's fishing*

Every time the hour hand moves over 1/12 of the clock dial ten persons are killed by accidents of various kinds The total exceeds 85 000 a year and during the same period of time the number of those injured runs into the millions But do not hesitate to travel for you will be as safe as in your own home and much safer than when strolling on the street In 1924 only a few more than 2 000 persons perished in railroad street car steamboat and airplane accidents Our artist has drawn an interesting comparison of the hazards of travel in public conveyances which gives much food for comforting thought. We would like to have included figures of bus and taxi travel but this is impossible While we are able to get such figures for individual cities and even whole states the entire country cannot be covered owing to the lack of uniform accident reporting and because of the incomplete records of the number of passengers carried We have consulted the foremost statisticians relative to this matter and they all consider that this problem is insoluble It must not be supposed that the record of safety in public travel was made without great effort in which the companies the regulating authorities and the public have all co operated We shudder at railroad accidents They often claim many victims but consider the number of passengers that are carried safely Street railways cause many accidents but again regard the immense number of passengers transported Our steamship figures are strictly limited to coastwise, lake and river traffic of the United States but the fatalities during transatlantic travel are also low Falls, burns, drownings et cetera due to accidents during transportation must also be considered but when all the data are at hand travel is found to be safe when compared with every-day pursuits in which we are exposed to many dangers



AIRSHIP "C 7" FITTED WITH PRESSURE RECORDING APPARATUS

To determine exactly the air pressures positive and negative which act upon the surface of an airship in flight the Navy Department inserted numerous pressure disks in the skin of C 7 and connected them with recording apparatus within the ship

New 6,000,000 Cubic-foot Airships for Our Navy

These Ships, Specially Designed for Helium Inflation, Will Have the Motors Mounted Internally, Thereby Reducing Head-resistance

By C P Burgess

Bureau of Aeronautics

A BILL providing for a five year program of construction of naval aircraft including two giant airships each of 6 000 000 cubic feet volume was passed at the last session of Congress and signed by the President Contrary to the general belief the bill appropriated no money so that the realization of this important addition to our air force still awaits the action of Congress

The two airships are by far the largest units in the new program and surely it is not too much to say that these marvelous structures larger than the *Leviathan* and of less mean density than air are also the most interesting feature

Stubbier Ship Provides Greater Strength

The Bureau of Aeronautics has prepared for the authorization of these giant airships by carrying out on the *Los Angeles* and smaller airships extensive experimental work of great importance and has proceeded with design calculations as far as practicable with the limited funds available so as to be in a position to proceed with the details of the design when the word Co is received from Congress

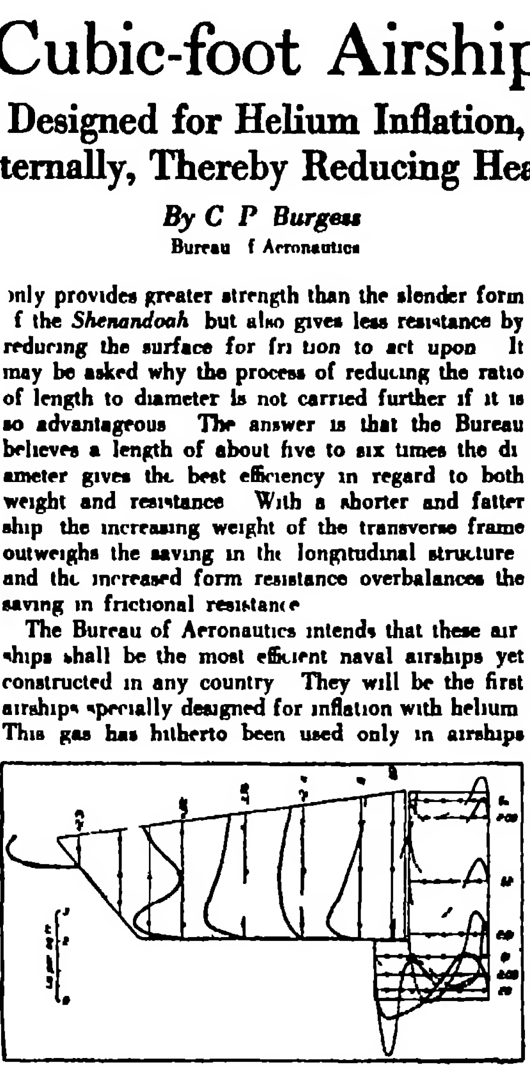
The new airships will each be more than twice the volume of the *Los Angeles* and the ill fated *Shenandoah* but relatively short and stout as shown by the following table of dimensions

Airship	*Shenandoah*	*Los Angeles*	Proposed
Volume cubic feet	2 150 000	2 600 000	6 500 000
Length feet	680	658	780
Maximum diameter feet	78 7	90 7	135

Note Dimensions of proposed ships are approximate only

The more buxom shape of the new airships not only provides greater strength than the slender form of the *Shenandoah* but also gives less resistance by reducing the surface for friction to act upon It may be asked why the process of reducing the ratio of length to diameter is not carried further if it is so advantageous The answer is that the Bureau believes a length of about five to six times the diameter gives the best efficiency in regard to both weight and resistance With a shorter and fatter ship the increasing weight of the transverse frame outweighs the saving in the longitudinal structure and the increased form resistance overbalances the saving in frictional resistance

The Bureau of Aeronautics intends that these airships shall be the most efficient naval airships yet constructed in any country They will be the first airships specially designed for inflation with helium This gas has hitherto been used only in airships



PRESSURES ON FIN AND RUDDER

This diagram shows in full outer lines the profile of the lower fin of the naval airship C-7 (see photograph above) The small circles are pressure disks The heavy lines show the amount of pressures recorded during a circling flight Full lines show positive dotted lines negative pressures

designed for hydrogen inflation A unique feature which is being considered is the placing of the engines within the hull instead of in cars suspended outside The interior positions of the engines will greatly reduce resistance, and give better protection to the personnel It is a remarkable fact that even after the *Shenandoah* broke in two not a man who remained within either of the separated parts of the hull was hurt With hydrogen the engines were necessarily placed outside the hull to reduce the fire hazard but this danger is eliminated by the use of helium

New Ships to Be Heavily Armored

It is proposed to carry an unprecedentedly large armament of machine guns for repelling airplane attack from all angles The ships will also have provision for carrying their own fighting airplanes for further protection against enemy airplane attack A large airship of this type has been designed by the Goodyear Zeppelin Corporation The number of machine guns carried is large The system of propulsion is by engines within the hull driving transverse shafts with bevel gears to the propellers supported on brackets

Another Goodyear Zeppelin design shows the new type of deep ring main frames which it is proposed to use in place of the shallow frames with a mass of cross wiring, hitherto depended on for transverse strength in rigid airships The ship was intended for passenger service, and the two internal longitudinal corridors with the passenger accommodations at the sides of the ship are interesting features.

The preliminary design calculations for the two navy ships have been based mainly upon a conserva-

tive development of the Zeppelin type of rigid air ship, but the Bureau of Aeronautics intends to invite other aircraft designers and builders to submit their ideas for consideration, so that the final design will be the fruit of the most expert engineering and aeronautical skill which America can produce

Few people realize the extraordinary strength of the hull of a modern rigid airship in proportion to its great size and marvelously small weight There is a very general impression that because the airship has no trussing through its center, it does not utilize its great depth to gain girder strength and stiffness This is a wholly erroneous view The truth is that the entire complex structure of longitudinal girders and transverse rings with diagonal wire bracing between the longitudinal and transverse members behaves in bending very nearly as a homogeneous tube

Diagnosing Pressures on Airships

The researches of the Bureau have included most elaborate series of tests with specially devised instruments to determine the actual air forces acting upon airships in flight, and the resulting stresses in the girders The investigations into the external air forces have been carried out mainly by the National Advisory Committee for Aeronautics on the Navy's rigid airship *Los Angeles*, and the small non rigid airship *C 7* The method of investigation was to transmit the air pressure at different points of the surface of the hull, fins, and rudders through quarter inch aluminum tubing to apparatus constructed to record photographically the pressure transmitted by each line of tubing Many thousands of feet of tubing were installed in the *Los Angeles* for these tests last spring Two of the recorders in the lower fin of the *Los Angeles* and the tubes leading to them are shown in one of our illustrations

Our illustrations include exterior views of the installation on the *C 7*, and a model of the hull of the *C 7* with the pressures along certain meridian lines represented by ridges, of depth proportional to the pressure At the extreme bow the pressure is positive, changing to negative slightly aft of the bow, and remaining negative all along the hull to near the stern where there is again a region of positive pressure, but not nearly so large as at the bow In the model, the ridges representing positive pressure are red, and those representing negative pressure are blue These regions of positive pressure at the bow and stern, and negative pressure or suction along the middle body correspond to the crests of the wake waves which may be seen at the bow and stern of a steamship, and to the hollow along the middle A moment's thought will make clear that the crest of a wave means more than normal pressure on the hull, and the hollow means sub normal

VIEW IN LOWER FIN OF 'LOS ANGELES'

Los Angeles 658 feet long 90 7 feet diameter with a volume of 2 600 000 cubic feet has been elaborately tested to determine the exact stresses to which she is subjected in flight Pressure disks and strain gages are connected with these recording apparatus within the fin

pressure, or, in other words, what is called suction

The investigation with strain gages into structural stresses was carried out by the Bureau on the *Shenandoah* and the *Los Angeles* with instruments devised and constructed by the Bureau of Standards Reduced to their simplest terms the strain gages consist of 36 elements, each about eight inches long and clamped at its ends to a girder where the strain is to be investigated The infinitesimal changes of length of the girder within the eight inch gage length due to varying loads are sufficient to change the electrical resistance of a series of carbon piles inserted within the instrument, and each instrument is electrically connected through wires carrying a small current to a mirror galvanometer apparatus at the observer's station in the keel of the airship The observer may note the simultaneous variations of strain in the selected girders in widely separated parts of the hull by watching the movements of narrow slits of light reflected from the galvanometers, and moving as the changing strains in the girders alter the resistances of the carbon piles The positions of the lights are also photographically recorded on a moving roll of sensitized paper

This apparatus has been used on many flights and its records have been of immense value in developing our knowledge of airship strength They have also shown the efficient working together of the various parts of the hull The writer was observing the strain gages on the *Shenandoah* when local failure of the bow mooring gear caused her to tear away from her mast in a gale The stresses in the hull had been high but they at once fell to almost nothing as the ship drifted with the wind

The experiments with apparatus for measuring the external forces on airships and the resulting internal strains have been carried out in such severe maneuvers and rough weather without revealing dangerous forces that it is certain that the squall which broke the *Shenandoah* must have been one of that type, which when they sweep along the surface of the earth in our mid western states uproot trees, overturn houses and have even been known to carry away steel railroad bridges

Rigid Ship Shows Steady Improvement

The *Shenandoah* was no stranger to squalls of very considerable violence Her runaway flight in a gale when she was torn from her mast is well known Much more severe air conditions because more turbulent were experienced on her famous voyage to the west coast Here is an extract from the log of that voyage As the San Gregorio Pass leading to San Bernardino was approached the dissolving clouds showed the passage to be full of vertical currents a really foreboding appearance, and the greatest difficulty was found in battling the strength of the wind rushing through the narrow opening between the two valleys' A few hours later the log records 'Heavy strato cumulus clouds again developed and moved rapidly from the northwest and soon obscured the moon In the darkness which resulted a heavy squall cloud nearly reached the *Shenandoah* unobserved but was seen in time to advise the elevator man to stand by for a heavy down gust As the ship entered this cloud she could be felt to descend much as an elevator and at the same time rain, sleet and snow were beating down upon her"

The new 6 000 000 cubic foot airships will be much stronger than the *Shenandoah* and wild indeed must be the fury of the elements which can wreck them

The rigid airship is the only type of aircraft which shows a steady and rapid improvement in performance with increasing dimensions It is also the only aircraft which is truly habitable and capable of operating at sea over vast distances and for days at a time through fog storm, and darkness

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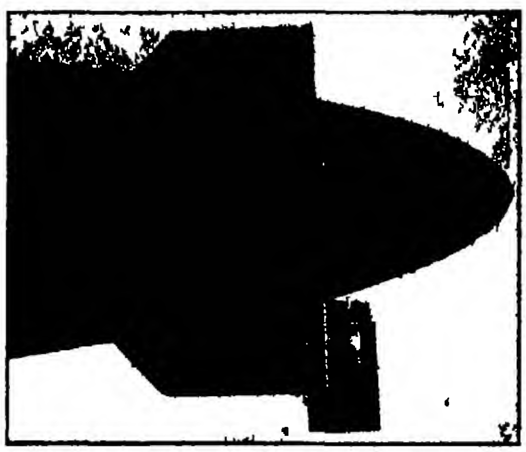
How truck wheels are made in a few crude operations from a steel I beam is one of the interesting stories of industrial mechanics that will be dealt with in a forthcoming issue

MODEL OF 'C 7" RIDGES SHOW AMOUNT OF PRESSURE

At the bow pressure "P" is positive and large It changes to negative just aft of bow and is negative N" all along the hull to near the stern where it once more becomes positive These positive pressures at bow and stern and negative pressures along middle body correspond to bow and stern waves of steamships in action and to the hollows along the mid sections of the ships It will be understood that the depth of the ridges at any part of the hull, is exactly proportional to the air pressure at that point



STERN VIEW OF C 7

Dark spots on the fin and body are pressure diaphragms, whose pressures are recorded ... by the observers stationed within the hull ... car See photograph at the top of the page By this means pressures and stresses are accurately determined

A New Tool for the Research Scientist

Many Interesting Experiments Have Been Performed With the Improved Cathode-ray Tube. They May Lead to Discoveries Which May Be Even More Startling Than Those Made With X Rays

It is no longer a secret that when the remarkable phenomena produced by means of the newly developed tube described on these pages—especially its effects on small animals at short distances—were first observed, there was considerable fear among scientists that it would receive a bad dose of the wrong kind of initial publicity it might be described by the sensational press as some new-fangled kind of "death-ray" No such purpose, it is almost needless to state, was in the minds of the scientists who developed it, and its effect on living matter is so comparatively limited in range that any such idea would be nonsensical

As anyone may learn from any elementary physics text book, the cathode ray is not in itself a new thing—far from it. What Dr Coolidge has done, essentially, is to modify the electron-discharge tube formerly used, in such a manner that the rays are powerful *outside*. As the accompanying article states, various interesting phenomena take place under the "super-cathode" rays but direct applications of practical value have not been announced as yet It is significant, however, in view of this statement, that few have been the developments of this kind which have not soon been applied in some direct manner to industry and our daily lives —*The Editor*

CATHODE rays or streams of high speed electrons were discovered by Crookes an English scientist in 1879 but their possibilities were limited because it was necessary to work within evacuated tubes Hertz in 1892 found that the cathode rays would go through metal foil placed in the vacuum tube Lenard his pupil made a big step forward when 30 years ago he cemented a metal foil window in the bulb of the tube and shot cathode rays through it and thereby for the first time obtained cathode rays out in the air Numerous advancements in cathode ray tube construction have been made by other investigators since then especially in regard to the output of the tube In the research laboratory of the General Electric Company there has now been devised by Dr W D Coolidge a tube which is characterized by greatly increased output much higher operating voltages and by being entirely sealed off from the exhaust system

Practical applications for the new tube have not yet been developed but its very high output has already led to the discoverery of phenomena which

DR W D COOLIDGE

Dr Coolidge is Assistant Director of the great research laboratory of the General Electric Company and inventor of the powerful cathode-ray tube described on these pages

had not been observed with previous tubes Such for instance are the production of a yellowish solid when cathode rays are passed through acetylene a colorless gas and the production of electrical discharges or explosions just beneath the surface layers of many substances Work with a gray rabbit led to the production of growths of longer and white hair on rayed areas When the leaf of the rubber plant was similarly bombarded latex or milk was exuded In addition to such results as these cathode rays in smaller concentrations were previously found by other observers to kill germs and spores cause many salts to become brilliantly fluorescent or to change in color and to effect physical and chemical changes of different kinds

Most of the effects are superficial phenomena, however since the rays have relatively low penetrating power At 350 000 volts they penetrate more than two feet of air but in substances of greater density such as salts, the penetration is correspondingly less

The power of the new cathode ray tube is evident in the statement that it produces as many cathode (or beta) rays as does a million grams of radium bromide but of lower average velocity

The window of Lenard's original cathode ray tube was 1 7 millimeters in diameter of aluminum foil 0 00265 millimeters thick cemented to a metal plate in the end of the tube The small diameter was the result of several circumstances It was difficult to obtain a larger piece of such thin foil without minute holes and it was difficult to support this thin piece of metal so that it would not collapse when the tube was evacuated His tube was operated with a permanent connection to a vacuum system and depended for its operation on the presence of a small amount of gas in the tube The gas molecules were ionized when a high potential was impressed across the electrodes The positive ions went to the cathode The bombardment of the cathode by these positive ions liberated the electrons which constituted the main cathode ray stream

In the new tube a current of a few milliamperes at voltages up to 350 000 may be used The window has a diameter of eight centimeters and is of nickel 0 0254 millimeter in thickness

The operation of the tube is similar to that of the modern pure electron discharge X ray tube, also a development of Dr Coolidge's in that the stream of electrons is liberated by a heated tungsten filament and in that a very high vacuum is

CATHODE RAY APPARATUS

Voltages up to 350,000 and currents of a few milliamperes are used in the production of the extremely powerful ray which penetrates more than two feet of air

THE NEW COOLIDGE TUBE

The window indicated at the left is a sheet of nickel only 1/2,000 of an inch thick. Through it the rays emerge from the interior near vacuum into the air

used. The tube may be sealed off from the exhaust system, and transported and used as easily as an X-ray tube Connected to the window, or anode, there is a copper tube within the anode arm, serving as an electrostatic shield to prevent puncturing of the glass by the high voltage.

The cathode is a heated tungsten wire from which the electrons come, the anode is a nickel window which is half of a thousandth of an inch thick and which is supported against the atmospheric pressure by a honeycomb structure of molybdenum. Reckoned in inches, the window is thin, but in terms of atomic layers it is thick—500,000 atom layers deep. The window is soldered to an invar sleeve to which the glass of the anode arm is sealed.

The filament is heated with a low-voltage current. Electrons evaporate from the filament at a rate determined by the temperature, which in turn depends upon the filament current A high voltage is impressed between the electrodes, the electrons from the filament thereby being driven at enormous speeds from the cathode to the anode, through which most of them go into the surrounding air.

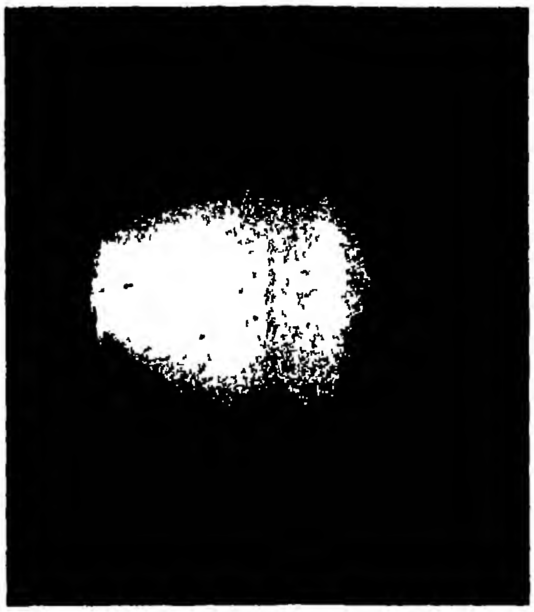
Causes Minerals to Glow

The electrons escaping through the metal window cause the air to assume a purplish glow, extending in front of and for some distance back of the window This luminous, essentially spherical mass may be as much as two feet in diameter, depending on the voltage, and is due to the ionization of the air by the high speed electrons The odor of ozone and the oxides of nitrogen is also noticeable Impact of the electrons on the window causes a slight production of X rays there, and additional X rays are produced when the cathode rays impinge on other substances outside the tube In addition to such phenomena as can be visually observed when a substance is placed in the path of the cathode rays,

in the path of the rays becomes heated by the bombardment of the rays and at the same time becomes a source of X rays, just as though it were within an evacuated tube The general design of the new tube is such that it seems possible to use still larger windows and more energy

The following experiments were conducted with a cathode-ray tube operating at 200,000 volts.

Calcite crystals, upon being rayed, glow strongly with an orange light and remain luminous for several hours. In addition to this, they may show



THE RAY DISCHARGES IN AIR

The window of the tube shows dimly at the left The luminous, purple discharge may reach two feet in diameter

bright, bluish-white scintillations These have been observed while the crystal is undergoing bombardment and for as long as a minute after raying By lightly scratching the rayed surface of the crystal with a sharp instrument, the scintillations may be induced for as long as an hour after raying

The area in the neighborhood of a scintillation loses all of its luminosity as the scintillation occurs, and then appears dark against the bright orange background Under the microscope the spot is marked by a little crater, with many tiny canals leading from it Examination of one of these areas with a microscope shows the presence

plosion crater Each appears to be a line of small globules, like a string of beads The reason for this beaded appearance is not fully understood

The luminosity of the ordinarily colorless and transparent calcite crystal is weird and uncanny To the uninitiated the mineral has the appearance of a red hot coal, and is touched with reluctance It is cold light, however, in that no appreciable temperature rise is apparent, and the crystal can be handled without danger The luminosity occurs within a very thin layer since the rays penetrate only about 1/10 millimeter into the crystal structure.

Calcite is not the only mineral which is caused to glow by treatment with cathode rays Some glow only while subjected to bombardment, and others continue to glow for some time, and various colors are apparent, according to the minerals used. In the case of granite, a mixture of different minerals, a very beautiful effect is produced by the rays since such colors as orange, blue, red and green become evident These colors are very brilliant while the granite is under bombardment, and persist less brilliantly for some time thereafter

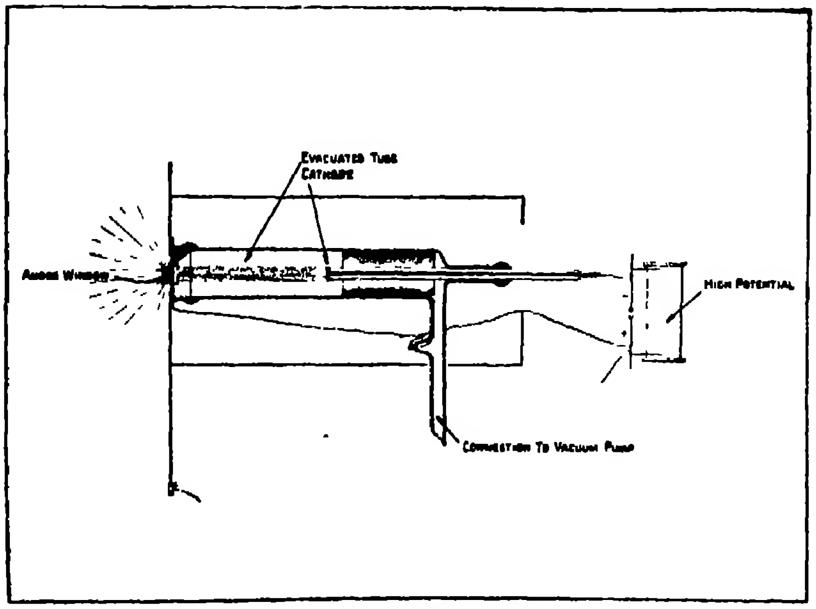
Intense Cold Works Weird Changes

Fluorescent screens such as are used with X rays are also caused to glow intensely when subjected to cathode rays A beautiful experiment can be conducted with a fluorescent screen of cadmium tungstate When subjected to cathode rays it gives off green light and shows very little phosphorescence, or afterglow If a strip of this screen is dipped into liquid air and is then rayed, it shows, upon warming up, several distinct luminescent periods, each having its own characteristic color, the color depending upon the temperature If, after the screen has somewhat warmed up and has passed through some of the colors, it is chilled again with liquid air and allowed to warm up once more, it will display no color until it has reached the previous higher temperature The screen then glows with the proper color for that temperature This radiant energy can be stored in the intensifying screen by maintaining a sufficiently low temperature, and can be liberated at any time by the application of heat

One of the most interesting experiments with the cathode ray has been the production of a solid by passing acetylene gas in front of the window of the tube while it is in operation The product, similar

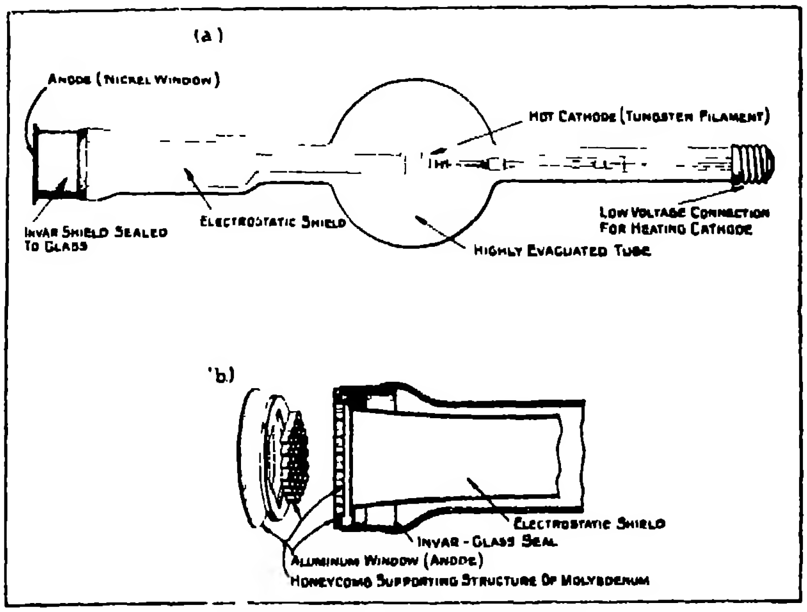
in minute traces either by a corona discharge in acetylene or by the use of radium emanation, has been produced in gram lots with the new tube

In producing the compound the gas is led through a chamber in front of the window of the tube, and the compound is formed immediately It can be collected as a fluffy, yellow powder, or under different electrical conditions directly as a varnish like film on metallic or other surfaces, to which it adheres tightly The powder has been found to be insoluble in all the numerous chemical agents



LENARD'S ORIGINAL CATHODE RAY TUBE

By cementing a thin, metal foil window to the end of the tube, Lenard passed the cathode rays out into the air Cathode rays are free electrons moving at high velocities When they strike anything, X rays, which are wave phenomena similar to light are produced



HOW THE NEW TUBE IS ASSEMBLED

The diagram and statements in the text explain this in detail The use of the same word "rays" to denote both X rays and cathode rays is illogical in a sense and often causes confusion As explained at the left, the two phenomena are in different causal categories

THE CATHODE RAY CAUSES CALCITE CRYSTALS TO GLOW STRONGLY FOR SEVERAL HOURS

Calcite is a common crystalline form of calcium carbonate of which limestone and marble are another form Under the cathode rays these crystals scintillate with a bluish white color in spot and emit orange light At a th pots which have scintillated show clearly on the crystal At b some of these scintillation spots are somewhat magnified At c a single spot is mag f d still more and shows the canals and crater At d, under a magnification of 360 diameters a canal system shows as a string of globules

that have been tried so far in the experiments

The high speed electrons emitted by the tube cause many liquids and solids to undergo marked chemical changes Just as acetylene is changed to a solid, so is castor oil solidified Crystals of cane sugar become opaque white and, if heated after wards, give off considerable quantities of gas If a solution of sugar in water is exposed to the rays and then tested with litmus paper, it is found that the solution has become acid

If a shallow dish of ordinary salt is exposed for a moment to the rays the salt turns brown By removing the surface layer of salt it is seen that the crystals beneath, not reached by the rays, have not been affected

If glass is exposed to the rays, it immediately turns purplish or brownish in color, similar to the way glass is affected by long exposure to X rays By the use of a metal stencil, the glass can be marked with any design, either very lightly or more deeply, depending upon the amount of exposure Porcelain and crockery can be marked in a similar way

The color effects produced by these experiments have been found to be more or less permanent Some colors are lost in a short time, and others continue indefinitely

Electrical discharges or explosions occur in a sheet of celluloid exposed to the rays at about liquid air temperatures These sparks or scintillations are observed in a dark room during and immediately following exposure Subsequent observation of the celluloid under a microscope will show that just beneath the surface there has been a discharge where each of the sparks occurred The craters in the celluloid are shown by a microscope not as straight lines of globules, as in the case of calcite, but as very irregular lines, due probably to the fact that calcite is crystalline in structure and celluloid is not.

If the leaf of a rubber plant *(Ficus elastica)* is pricked with a pin point, a white latex or milk is exuded from the puncture When a portion of the leaf is rayed with one milliampere of current for 20 seconds at a distance of one inch from the window, the rayed area becomes covered immediately with the white latex, indicating that the electrons have in some way caused the cell walls to become permeable to the latex

An exposure of only 0 1 milliampere for one second causes a color change in the leaf, with subsequent drying out of the rayed area to a depth corresponding to the penetration of the rays

EFFECT ON RABBIT S EAR

After exposure to cathode rays over the two lengths of time indicated at le scabs formed but soon fell off taking the old hair with them and leaving bald spots

Rays Always Under Control

X rays do not kill bacteria but the 200,000 volt cathode rays do, even with an exposure of as little as one tenth of a second

One milliampere of current for a fraction of a second has been found sufficient to cause immediate paralysis and subsequent death of fruit flies

A peculiar effect discovered during experiments with rabbits is that a profuse growth of snow white hair is produced by exposure to the rays The ear of a rabbit was rayed with 0 1 milliampere for 0 1 second over an area one centimeter in diameter The rayed skin became deeply pigmented within a few days, and the hair came out Seven weeks later new hair appeared This new hair was longer and was a mixture of white and gray in color

With 100 times the exposure—one milliampere for one second on a similar area—a scab formed over the rayed area The scab came off a few days later, taking the hair with it A profuse growth of snow white hair started two weeks later, and soon became much longer than the original hair

In further experiments the exposure was increased to one milliampere for 50 seconds Scabs developed on both sides of the ear, and when they fell away a hole was left in the ear The edge of this hole was at first without hair, but later became covered with a growth of the snow white hair

Among the most important of ray producing devices or substances available for scientific research are radium compounds and similar products They are constantly disintegrating and, in so doing, give off alpha, beta and gamma rays The beta rays are really high speed electrons, and in this respect are identical with those of the cathode ray tube, but of higher average velocity

Radium, however, is uncontrollable in that the experimenter cannot govern the velocity at which the electrons are bombarded into space The cathode ray tube offers a source of high speed electrons, or beta rays, which is at all times under the control of the experimenter, both as to quantity and velocity Added to this there is the fact that one of the tubes will produce a very high concentration of the rays—one tube releasing as many electrons per second as a million grams of radium bromide

Much has been learned in the past of the properties of cathode rays by brilliant experiments conducted by numerous investigators With the new tube—completely sealed, portable, always under control, capable of producing a very powerful stream of high speed electrons—the field has been opened for conducting experiments previously impossible, and it is to be expected that our understanding of electronic phenomena will be greatly increased thereby

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Insects cost the United States two billion dollars a year! Rather expensive pests, to be sure, but the Government is combating them Read of the fight and results in an early issue.

SEVEN WEEKS LATER

The "bald spots" produced by exposure to the cathode rays are now covered with new hair In one spot, it is gray and white and in the other, it is white

The Scientific American Sport-plane Trophy Race

Extraordinary Speed Was Attained at the Philadelphia National Air Races

By Prof Alexander Klemin

AT the National Air Races the classification of many events is based on the engine piston displacement measured in cubic inches, one cubic inch corresponding approximately to one fourth of a horsepower In the races for small engines the classifications ran under 510 cubic inches, under 300 cubic inches, and under 80 cubic inches engine displacement With engines of the 80 cubic inch rating, possibilities are limited It is doubtful whether a pilot and passenger can ever be carried with complete security by such an engine certainly no very extended range is to be expected in addition to the carrying of two occupants

The plane having an engine of 510 cubic inches and a horsepower of something around one hundred can hardly be considered a sport plane Even if its initial cost is low, its fuel and other running expenses are likely to remove it from the popular sport plane class The Scientific American Trophy Race stipulated the intermediate value of under 300 cubic inches We believe that this is a particularly useful rating and that with engines of this displacement or a little under the ideal sport planes for pilot and passenger will soon be developed

In some respects the light plane race is the most interesting event of a National Air Race Week The airplanes purchased by aerial service operators and by air transport companies are under continuous observation all the year round Their performance and service characteristics are well known to all professional interests However the small planes are, at present, mainly in evidence only at races and therefore their design is always somewhat of a surprise Their showing at the meets is their best selling argument The one at Philadelphia was no exception, and the comparatively few light plane entries earned a disproportionate amount of the visitors' interest

WING CONSTRUCTION OF THE WINNER

A single built up box spar is employed with veneer top and bottom but with fabric covering the rest

The small sport plane is not just an ordinary plane reduced in size It has very definite characteristics of its own It is particularly sensitive to control, and very maneuverable, its sensitivity may even be excessive and certainly no controls on the sport plane should be balanced It has, as a rule, a lower landing speed and a correspondingly greater safety When the heavily loaded transport ships crash, there may follow heavy damage and serious danger The small planes inspire the greatest confidence by their ability to escape serious damage even under untoward circumstances Further, by virtue of their smaller dimensions, when out of control as in a bad stall, they need a lesser height for recovery of normal flying attitude a statement which the theory of dynamic similarity renders perfectly demonstrable

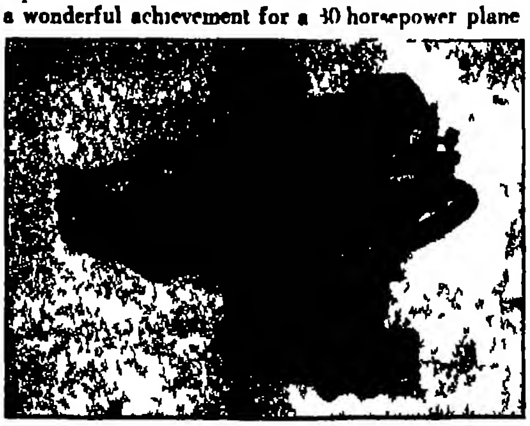
Their small dimensions particularly when the wings can be folded, makes their housing and transportation to the flying field particularly easy At the same time, they are real flying craft able to negotiate quite a fair distance under poor weather conditions Thus, Jack Laass who piloted the Driggs *Dart* from Dayton, Ohio to Philadelphia on a flight of some 400 miles, encountered rain fog and mountains having peaks of 3000 feet with fog covered valleys yet arrived without mishap Not once had his faithful little motor missed and not a drop of water had found its way into his cabin enclosed with pyralin

A PRIZE WORTH STRIVING FOR

This illustration shows the design of the bronze plaque that was awarded in the light sport plane race

Besides the requirement as to the 300 cubic inch engine displacement, the Scientific American Trophy contestants had to carry a minimum load of 170 pounds, exclusive of fuel, oil and water, a light pilot having to be compensated for by a sufficient quantity of ballast They could be one or two seaters The race to be run on Tuesday, September 7 (though actually delayed by rain) was to cover 60 miles, 12 times around a closed course of five miles, with three marking pylons All contestants were to start from "at rest," with engines running

The winning plane was designed by F F Seiler of the Kreider Reisner Aircraft Company of Hagerstown, Maryland, and is an interesting example of the simplicity and efficiency which can be attained in the construction of these small planes Piloted by A H Kreider, it averaged 91 5 miles per hour over the course, an extraordinary speed record for planes of this type in a closed circuit race One lap of the race was timed at 99 4 miles which seems a wonderful achievement for a 30 horsepower plane



THE WRIGHT MOREHOUSE ENGINE

This type will drive a small plane at 90 miles per hour consuming a gallon of fuel in about 36 miles

The M 6 wing curve a double cambered surface, proved quite efficient and its constant center of pressure (due to a reversed trailing edge) helped in the structural design The 20 foot span wing is built very simply with one veneer covered spar, the fabric covering terminating in a wire at the trailing edge

The total area of the wings is only 60 square feet, and the over all length is but 15 feet The total weight fully loaded is only 490 pounds The design of the plane is simplified also in the one piece horizontal tail surfaces the elevator and stabilizer being combined A wing surface of four square feet is attached to the axle and provides some lift as well as giving a streamline to the axle

One interesting tendency is noticeable in the design of these light planes the placing of the wing at the bottom of the fuselage and near to the ground as in both the Kreider *Midget* and in the little Ford monoplane Apparently designers like to get all the lift they can by placing the wing near the ground and so reducing both landing and get away speed

The second prize went to Heath of Chicago flying the Heath *Tomboy* with a very clean cantilever monoplane design who averaged 91 2 miles per hour, using the Bristol Cherub engine C D Chamberlain finished third with a two seater of the vintage of 1920 and the Driggs *Dart* likewise equipped with a Wright Morehouse finished last

SIDE VIEW OF KREIDER MIDGET

The little craft is streamlined just like a racer even to the pointed spinner on the propeller

with a speed of 85 4 miles per hour It was perhaps handicapped by the long and difficult trip across the mountains which we instanced as a proof of the rugged qualities of these light planes and it was somewhat old in construction

In previous air meets plane designers of small craft have had to use either foreign built engines or else motorcycle engines adapted to plane use It was gratifying to have the Scientific American Trophy carried off by an American built plane with an American built small engine The Wright Morehouse has two cylinders horizontally opposed It is rugged simple well balanced and reliable With a bore of 2 75 inches a stroke of 3 625 inches and a piston displacement of only 80 cubic inches it delivers 29 horsepower at 2 500 revolutions per minute It weighs but 89 5 pounds The fuel consumption is 2½ gallons per hour at full throttle

The Wright Morehouse actually showed up better in the race than the foreign built Bristol Cherub, of similar power and design In the various laps of the race the Cherub missed a little in Heath's plane The Wright Morehouse never gave an indication of trouble

WHEN RADIO WAS KNOWN AS WIRELESS

The old rotary gap of 1912 made a deafening crash as the sparks leaped between the electrodes. In those days it was the last word in wireless but today it is obsolete, having given way to the modern vacuum tube and the quenched gap

A CONTACT WITH SHIPS AT SEA

The obsolete set at Bush Terminal, Brooklyn, which lost its popularity when broadcast listeners complained of interference The transmitter was tuned by the wheel and lever A rotary gap is on the motor shaft and a quenched gap is on the floor

Edison Glimpsed At Radio in 1875

Scintillating Sparks Led to Discovery of "Etheric Force"

By Orrin E Dunlap, Jr

ON the evening of November 22, 1875, nineteen years before Marconi made his first transmitting and receiving set, Thomas A Edison observed a strange spark in one of his experiments with a magnet, and after study he proposed the name of "etheric force" for the phenomenon Edison described his discovery in the Scientific American, December 25, 1875

This disclosure by Edison, together with the theoretical prediction of ether waves outlined by Professor James Clerk Maxwell in 1867, and the creation and detection of electromagnetic waves by Heinrich Hertz in 1886, were developments which helped Guglielmo Marconi to "stand the egg on end," as Sir William Preece referred to Marconi's triumph However, as one writer has said, "Marconi's creation, like that of the poet who puts words of men in perfect lyric, was none the less brilliant and original"

How "Etheric Force" Was Discovered

Edison first noticed the distinctive character of the "etheric" spark while experimenting with a vibrator consisting of a bar of Stubb's steel, fastened at one end and made to vibrate by means of a magnet He and his associates observed a spark coming from the core of the magnet They had often witnessed the same phenomenon in connection with telegraph relays when iron filings were between the armature and the core, but they had always supposed it to be caused by inductive electricity On this occasion the spark was so bright that they suspected something more than induction

Edison found that by touching any portion of the vibrator or magnet with a piece of metal, the spark was produced The end of the vibrating rod was then connected by means of a wire to a gas pipe overhead, whereupon a spark could be drawn from any part of the gas pipe in the room Subsequently it was found that a spark could be drawn from any part of the whole system of the city gas pipes. This indicated conclusively to Edison that a new force was at work which was not amenable to the laws of voltaic or static electricity

Tested in various ways the new current refused to obey any of the established laws of electricity further than that it traversed metallic conductors A lack of polarity was observed as one of its peculiarities It was indifferent to the earth and consequently its capability of transmission through uninsulated wires and its independence of electric nonconductors was noted

Previous to Edison's discovery it was accidentally found that when the contact of an electric current, which magnetized a large electromagnet, was broken very near one of the poles of the electromagnet, the spark was so much increased in intensity as to produce a powerful snap, like that of a pistol, while the breaking of the contact at a distance from the electromagnet did not produce such an effect The next thing observed was the drawing of the sparks from the iron electromagnet, or from its armature

Edison went deeper into the subject than previous

International Newsreel

THE FATHER OF THE VACUUM TUBE

Thomas A Edison in his laboratory He was the first to discover the electron discharge in a lamp

experimenters, but if he had been more interested and had delved deeper into the mystery, radio broadcasting might have begun much earlier than 1920, and radio motion pictures might have been in vogue today Edison did not apply for a patent on his discovery.

He pointed out at the time that one of the most remarkable features of the new form of electricity, which proved its perfect neutrality was that it had no apparent effect upon the human body and none on the most delicate of electric tests, the properly prepared frog's leg, unless an exceedingly strong galvanic current was used around the magnet.

Edison's Discovery Doubted

Edison conducted experiments to show that the new current differed from electricity, especially inductive electricity, in that its sparks were different in appearance and effect The sparks scintillated. The current differed from electricity in general in its entire independence of polarity It did not require a circuit nor did it require insulation It would not charge a Leyden jar It failed to affect chemical compounds sensitive to electricity, for example, iodide of potassium It had no effect upon electroscopes or upon galvanometers. It was not felt by the tongue and caused no contraction in a sensitive galvanoscopic frog

Little did the public realize fifty-one years ago that this strange spark might be the basis of a world-wide communication system destined to flash messages and entertainment to millions, simultaneously, at the speed of light, 186,000 miles a second. After reading Edison's announcement relative to the etheric force, one man wrote, "I cannot but believe that somebody is somewhere mistaken. Mr. Edison is perhaps sincere in his belief that he has discovered a new and valuable force; but he will soon learn that the hopes are delusive and evanescent."

In commenting upon the discovery the editor of the Scientific American in the January 1, 1876, issue said, "It is a new and distinct phase of force, an unstudied phase of electricity, which will rank Mr. Edison the most fortunate and eminent of scientific discoverers."

IT SOUNDED THE SPARK'S DOOM

John Fraser, outside pick up engineer at station KDKA holding one of the 10 kilowatt transmitting tubes used at the Pittsburgh station The metal water cooling jacket is at the base of the glass part of the tube

Some believed the new spark to be the result of induced electricity, but the electrical wizard proved that it was not inductive In his test he used the following apparatus, with all parts insulated except the gas fixture a battery, telegraph key, electro magnet, bar of cadmium, mirror galvanometer, gas pipe and a spark gap formed by two graphite points about the size of a lead pencil

The unknown current was passed through the bar of cadmium and through the galvanometer without the slightest deflection, and nothwithstanding the gas pipe connection, which would drain the wire of induced electricity, if there were any, bright sparks were visible between the graphite points in response to the motion of the telegraph key

Since that time, similar sparks leaping tiny metal lic gaps have saved thousands of lives at sea but today the more efficient and economical vacuum tube has replaced the old spark as a means of generating electrical oscillations to set the ether in vibration and so make wireless communication possible

Edison's announcement spurred many others to experiment and try to produce the etheric force All attempts to generate the force with a Holtz machine or Leyden jar were fruitless It could only be produced by means of an interrupted current from several cells, using the vibrator magnet, or an electromagnet operated with a telegraph key and battery Then the current followed the wire con nected with the core of the magnet, or with a piece of metal within the magnet's sphere of influence

The force manifested itself as a spark when the wire was rubbed against a piece of metal when a body of metal such as a gas pipe or stove was con nected with the wire and touched by a piece of metal such as a knife blade, or when two carbon points were brought in contact within a darkened box one carbon being connected with the wire leading to the magnet The entire apparatus had to be carefully insulated to exclude inductive electricity Sparks were also obtained when the conducting wire was rubbed by a piece of metal held in the hand, or even when the wire was rubbed by its own free end

"Edison Effect" Applied to Radio

The conducting wire did not have to be insulated It could be led through water wound around large metallic bodies, or trailed along the ground, yet the scintillating sparks appeared One rainy night Edison strung the wire from the vibrator out of doors across the sidewalk, up and down the block in the gutter, through which a torrent of water was flowing, thence by an alley to the rear of his labora tory, where sparks were distinctly seen between the carbon points in the dark box Those who watched the sparks caught just a glimpse of radio!

While experimenting with incandescent lamps in 1880, the curiosity of Edison was aroused by black deposits inside the glass bulb and a blue halo sur rounding one of the legs of the carbon filament He thought that the blackening of the glass might be caused by a molecular bombardment He coated a lamp on the outside with tinfoil and found that when it was connected in series with a galvanometer and the positive terminal of the filament there was a current flowing across the gap between the fila ment and plate He then placed a piece of plat inum foil between the legs of the filament inside the bulb and the effect was greatly increased The phenomenon was called the "Edison effect"

Thus it was Edison who first discovered that a glowing filament in a partial vacuum within a glass bulb not only shed light, but also a shower of elec trons, tiny specks of negative electricity so small that the most powerful microscope cannot detect them These little particles of electricity have been described by one scientist who states that if a drop of water which includes a great number of elec

FIFTY ONE YEARS LATER

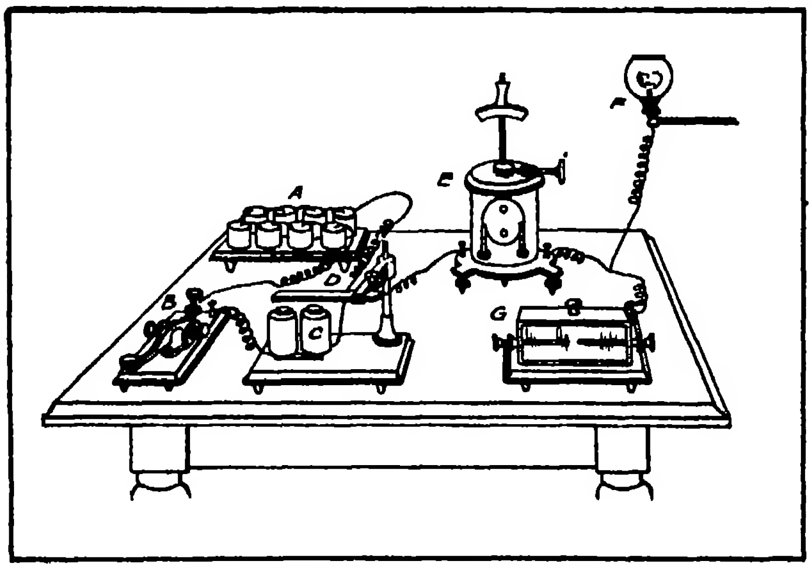
A half century after Edison's discovery of "etheric force" the spark is gone—replaced by the vacuum tube This photograph shows eight of the 10 kilowatt water cooled tubes at KDKA Note the rubber hose for the water

trons, because of the hydrogen and oxygen within it, were magnified to the size of the earth each elec tron magnified in proportion would be about as large as a grain of sand Nevertheless these elec trons are to the radio receiving set as blood is to the human system

Edison continued his experiments and invented the electric light but did not perfect the vacuum tube detector and amplifier for radio despite the fact that he had uncovered its basic principle

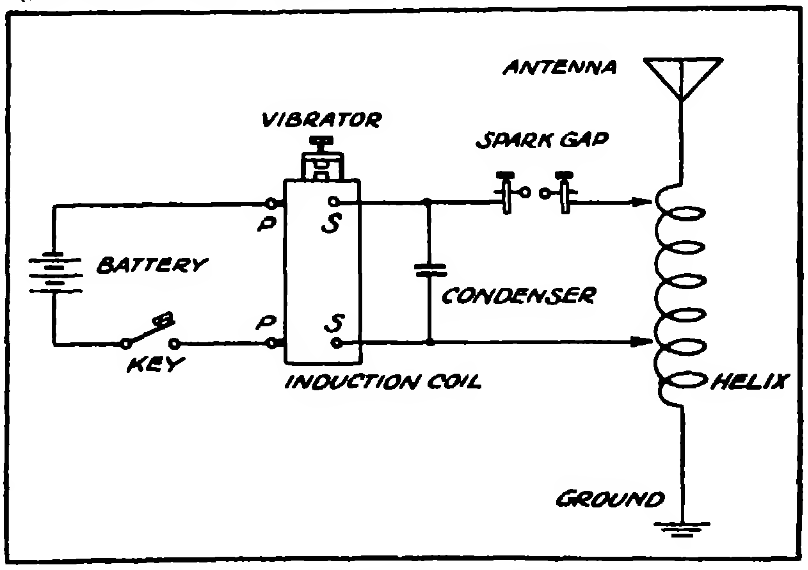
In 1901 Dr James Ambrose Fleming of Eng land, introduced the Fleming valve and applied it to wireless reception He installed a small metallic plate within the tube and connected it to the posi tive terminal of a high voltage battery so that a con tinuous stream of electrons would flow between the filament and plate Since opposite electrical charges attract each other the electrons which are negative electricity are attracted by the positive charge on the plate, forming a continuous stream between the filament and plate

Dr Lee de Forest in 1906 improved the Fleming valve by adding a third electrode called the "grid," making the tube more efficient and practical He named it the aud[illegible]



TESTING EQUIPMENT FOR ETHERIC FORCE

Edison's instruments, reprinted from the Scientific American of December 25 1875 show ing the layout used to produce and detect the strange sparks "A" indicates batteries "B" key, "C," magnets, "D, armature, "E," galvanometer, "G," gap, "F," gas fixture



ONE OF THE EARLY WIRELESS TRANSMITTERS

Amateur experimenters from 1901 to 1910 used this simple circuit to call back and forth Later transformers were substituted for the spark coils and now vacuum tubes are the favorite means of generating current to set the ether in vibration

How Science Can Improve Your Golf

A Highly Interesting Article on the Reasons for the Vagaries of the Flight of Golf Balls that Was Prompted by a Former Article by Professor Sheldon

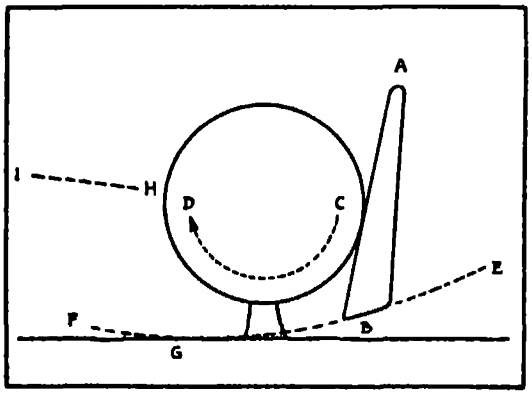
By P. A. Vaile

Author of "Swerve or the Flight of the Ball," "Modern Golf," "Modern Tennis," et cetera

IN a recent issue of the Scientific American, Professor H H Sheldon, Ph D, Chairman of the Department of Physics, Washington Square College, New York University, writes in a very interesting manner of "The Physics of Golf Balls."

In dealing with the swerve of the ball Professor Sheldon says: "It may be asked, 'Why not use a smooth surface and thus largely avoid the spin which results in deviation?'"

My answers to that are (1) A smooth golf ball is useless for golf because its flight is very erratic It ducks and soars in a most uncomprehensible manner. Possibly Professor Sheldon, if he would devote his mind to this phenomenon, might be able to explain it Professor Sir J. J Thomson, the renowned physicist, in a letter to me, confessed that he was unable to do so I gave my explanation of the matter in the Scientific American some years ago, but I am always looking for further information on the subject (2) The effective spin of a golf ball is affected very little by the nature of the marking of the cover It is produced, practically entirely, by the nature of the blow



HOW BACKSPIN IS PRODUCED

A downward glancing blow by the face of the golf club against the ball, causes the latter to spin in the direction of the curved arrow In this drawing, "AB" represents the face of the club, "EF" indicates the arc of the club head during the stroke, "CD," the backspin produced by the downward glancing blow with either wood or iron club, "HI," the line of flight after the impact and "G," the point, where the club reaches the lowest point of the swing

To produce any appreciable amount of spin the club head, at the moment of impact, must be moving obliquely across the initial line of flight

Professor Sheldon goes on to say "The answer is that one form of spin, an underspin produced by hitting the ball slightly below the center, is highly desirable, for this prolongs its flight"

It is fairly obvious that hitting a ball slightly below its center will not, of itself, produce underspin, or backspin, as golfers call it, for, in order to get the ball into the air it must be hit below the center. Yet, many balls so hit have the slice and pull spin, which are totally dissimilar from backspin in their results, both in the air, or carry, to use the golf term, and in their action after pitching, or coming in contact with the earth.

The beneficial backspin of golf is obtained by a downward glancing blow that hits the ball before the club head has reached the lowest point in the arc of the stroke To put it rather graphically, the spin in both golf and tennis is obtained by the striking implement brushing across the ball and thus causing it to roll on the face of the club or racket. To settle a controversy about the amount of roll of the tennis ball on the racket, in the American service, I had the strings of some rackets colored with lampblack and oil and allowed to dry. I then served the American service, using, of course, perfectly new balls, and obtained a perfect impression of what took place Somebody will some day do the same thing in golf.

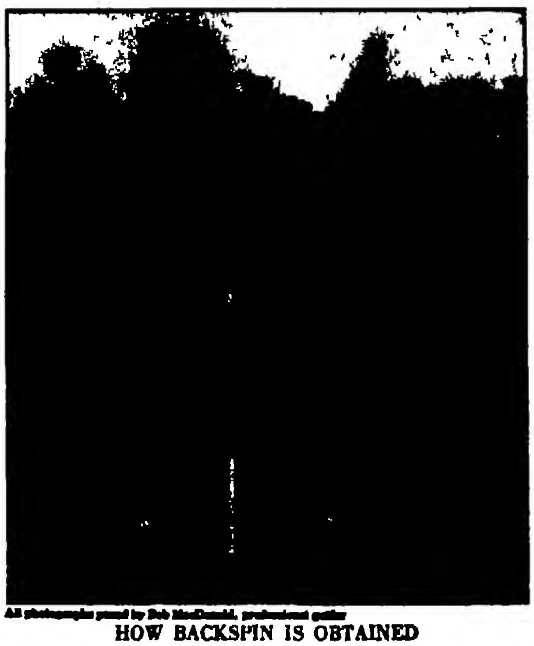
Professor Sheldon speaks of its being "sometimes desirable to use some slice or pull, thus obtaining the curved flight due largely to the effect of markings on the ball"

Why You Hook or Slice

As I have stated, the marking of the ball has little, if anything, to do with the production of spin I cannot, indeed, see why it should be supposed to influence spin to any great degree, for the marking is of the same nature all over the ball, and, therefore, apart from adventitious air currents, one side should provide as much resistance as the other

Professor Sheldon says "The proper surface markings should obviously be those that will give the maximum effect due to spin, with a maximum of air resistance. At first it might seem that these two things would be the same, for the spin effect is, itself, due to air friction."

I maintain and have fully explained in my book "Swerve or the Flight of the Ball" that spin is mainly, in fact, almost entirely produced mechanically by the nature of the blow I should feel very diffident in making this statement if it were merely my knowledge of physics against Professor Sheldon's for he has probably forgotten more about that than I shall ever learn, but this information comes to us from a physicist to whom the world bows, no less than Sir Isaac Newton.



All photographs posed by Bob MacDonald, professional golfer

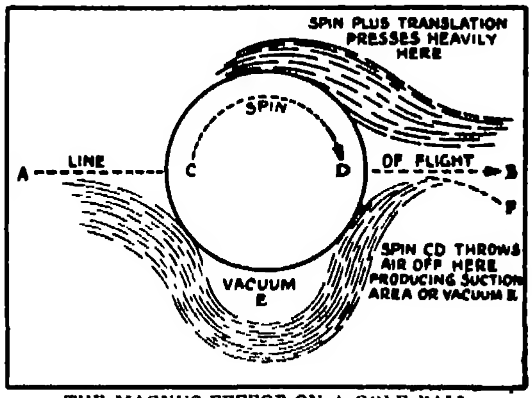
HOW BACKSPIN IS OBTAINED

A demonstration of the correct stance and address to use when it is desired to produce backspin The hands are in front of the club head This tends to make the lowest point of the arc come in after the ball is struck, thus producing a downward glancing blow If the stroke is made properly, the ball will carry true

Writing to Oldenburg in 1671 about the dispersion of light, Newton said: "I remembered that I had often seen a tennis ball struck with an oblique racket describe such a curved line."

The great master physicist and mathematician had grasped the main principle, or one of them, correctly, for he then said "that the parts on that side where the motions conspire must press and beat the contiguous air more violently, and there excite a reluctancy and reaction of the air proportionately greater."

The very curious thing, however, is that Newton was wrong in his premises. To strike a golf or tennis ball with an oblique club or bat would push the ball away to one side or the other but would not impart much spin The true cause of spin in golf or tennis is now well recognized as coming not from an "oblique" instrument hitting the ball, but from the instrument hitting the ball *an oblique blow*.



THE MAGNUS EFFECT ON A GOLF BALL

A combination of forces pulls the ball toward "F," as in the slice in golf Turn this diagram upside down and put the page in a vertical position and you will have the explanation of the action of backspin. "AB" is then the line of flight, "CD," instead of sidespin, becomes backspin and the vacuum "E" is on top of the ball As the spin is now fighting gravity directly, the curve toward "F" will be much less pronounced than in the case of sidespin

Golfers will understand this clearly, for they know that a slice or cut is made by playing from the outside inwards across the line of flight, with the face of the club at a right angle to the line of flight at impact, whereas it would be disastrous to have the face of the club oblique to the line of flight, for unless the error were very slight, that would mean an annoying drive into the rough every time.

Professor Sheldon says. "It should be observed, however, that the velocity of any mark on the ball due to rotation may be quite different from its velocity due to translation through space."

This statement will be quite unintelligible to about 99 percent of those who read it, so I shall reduce it to the utmost simplicity and give, in a few words, the main reason for the swerve or curve of a golf ball, a tennis ball, a baseball or any other kind of spinning sphere in the air.

In quoting anyone I do not care ever to insert a comma. Professor Sheldon has placed his qualifying phrase "due to rotation" peculiarly, especially as it is not between commas. His statement should be: "It should be observed, however, that, due to rotation, the velocity of any mark on the ball may

be quite different from its velocity due to translation through space."

This is not scientifically accurate, for let us say, in backspin, if the mark happened to be on the axis of spin, the velocity of that point and the velocity of translation would be exactly the same. However, I understand exactly what Professor Sheldon means and I am now about to hand it on to you in a manner that means a few million arguments amongst those who own motor cars or play baseball, tennis or golf

Very few people understand that the top of a wheel is moving faster through the air than the bottom. Please understand that I am putting Newton's discovery and Professor Sheldon's statement into popular form.

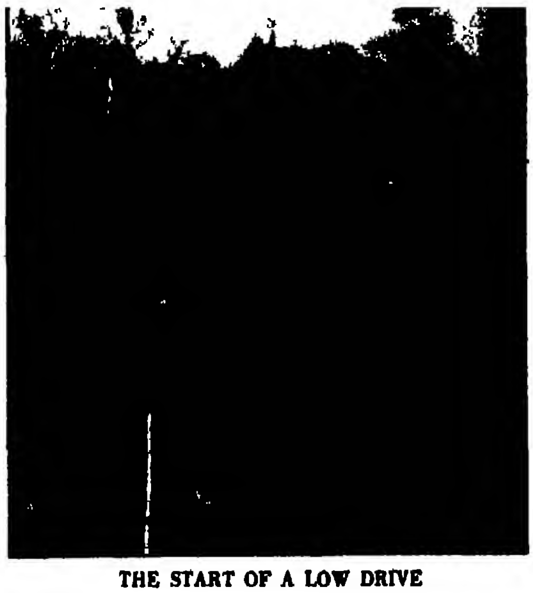
Try This Simple Test

I know that to many this will sound ridiculous so I shall suggest a simple proof. Put a plate, an ash tray or anything circular up against the wall or any vertical object on the table. Make two marks on the circumference of the circular object in a vertical line running through the center Put a mark on the table or wall where the lower mark on the plate is. Do the same above the plate, so that all four marks are in the same vertical line. If you happen to be where other circular objects are scarce, a silver coin or anything that will take a mark will do.

Now roll your plate forward about an eighth of the circle and, unless you know about this, you will be astonished to see that the marked spot on top of the wheel, has advanced six or eight times—I have never calculated it—as far as the spot on the bottom of the wheel The marks on the vertical stationary object will serve as guides

The simple explanation of this is that the axis of rotation is moving. If you jacked your car up and spun the wheel, all opposite parts would, of course, move through the air at the same rate. In the moving car, however, a point at the top of the wheel has the speed of progression of the vehicle plus the speed of forward rotation, while at the bottom we have a minus quantity in the backward rotation of the wheel

Thus we find that our golf ball gets most friction on the side where forward spin and progression, or translation, agree Following the well-known law that a projectile seeks the line of least resistance, the ball edges over to the non resisting side,



THE START OF A LOW DRIVE

This interesting photograph was taken just after the impact between the head of the club and the ball. Notice how low the head of the club is kept and also the low flight of the ball. The streak of white in the lower right-hand corner of the picture is the ball in flight The fan-shaped band is the club as it is carried through

PLAYING A STYMIE

The ball has just been struck and is in the air Notice the shadow of the ball The shadow of the club head proves conclusively that the head is in contact with the ground This indicates the low finish of the stroke that produces backspin and which aids control of the run when making shots with an iron club

where the backward rotation is causing less friction. That briefly is the main cause of all deviation from the line of flight that is due to rotation

There is another contributing cause that escaped the notice of even Newton and this will come as a revelation to sportsmen the world over, even to those who already know what I have just explained

Most people have heard of Flettner's rotor boat, the sail less boat that is propelled by objects that look like funnels These are rotated by a small engine The air rushes against them and they try to swerve just as a golf ball or a baseball does, but they cannot because they are attached to the boat, so they just push the boat along

Something New in Ballistics

Flettner, in carrying out his invention, used what is called the Magnus effect This was discovered, if I remember correctly, by Magnus in 1853 Magnus found that not only does one side of the funnel get pushed as we have seen, but he also discovered that there is a suctional effect on the opposite side, amounting to a semi vacuum where the backward spinning side throws the air current off the cylinder Thus it will be seen that the "swerve" of the funnels is caused by a push from behind and a pull from in front

Now, instead of thinking of your funnel, or rotor, as vertical, consider it as a horizontal cylinder with backspin facing into a direct wind You will now see that there is one force pushing it upward and another pulling it upward

Forget that it is a cylinder and look endwise along it You have now a diagram of a golf ball with backspin and the proof of something utterly new in ballistics, something that may increase your idea of the value of backspin, namely that above your golf ball is a suctional or lifting force, that, for all you know to the contrary, may be of greater importance than the well-recognized extra pressure on the lower side.

We have here, in effect, a force analogous to the area of negative pressure, or vacuum, on top of the wing of an airplane. Not many people know that the greater part of the lift is done by the top of the plane's wing, yet so it is Sometimes almost 90 percent, and possibly more since I dabbled in aviation, is done by the top of the wing

Here then is a revelation to sportsmen and something for the physicists to calculate, but, in order to do it successfully they must know golf as well as physics Even so eminent a scientist as Sir J. J. Thomson fell into strange errors when he attempted to deal with the flight of the ball He gravely stated that the beneficial backspin of golf was obtained by the loft of the club Of course, if this were correct, we could just "angle" the faces of our clubs, hit a straight forward drive and get pulls or slices at will, according to the club we used, but, as we all know, that will not work in practical golf. He also stated that topspin in tennis was obtained by hitting the ball on top, which, of course, would merely drive it onto the ground or into the net To get really correct information as regards the physics of golf, one must know the game

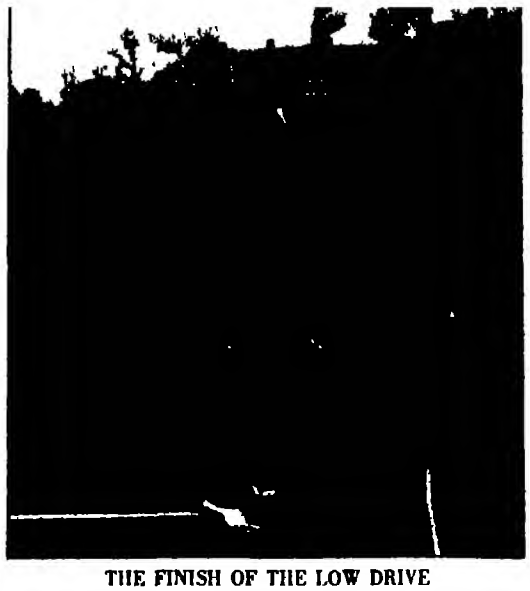
Where Science and Practice Disagree

I have been very much interested by Professor Sheldon's work and now that I have pointed out this hitherto unsuspected force that is acting on all swerving balls, I am hoping that he will devote some attention to it and also add to, or correct, my explanation of the alleged mystery of the flight of the smooth ball, that utterly baffled Professor Thomson.

I notice that Professor Thomson has made experiments measuring the difference in pressure on the two sides of a spinning golf ball He rotated the ball rapidly on a spindle, directing at it a blast of air, and found the pressure difference by means of a water manometer This is interesting but here, again, Professor Thomson is falling into grave error from a golf point of view He is assuming that the axis of rotation in the pull and slice are vertical, whereas they are not

The axis of a sidespin such as slice and pull naturally approximates the angle of the loft of the club on which it "rolled" in order to get its spin and, in the slice, is slightly tilted back toward the player In the pull the axis of rotation leans inwardly to the player at roughly an angle of 40 degrees Their utterly dissimilar flight and run should be enough to put anyone on his guard against assuming, and even stating, as Professor Thomson does, that their axis of spin is vertical and that one is merely the converse of the other

The problem of supplying water to the residents of Jerusalem is a great one, but modern engineering has come to the aid of the people. Read about this latest achievement in an early issue.



THE FINISH OF THE LOW DRIVE

The ball, traveling away from the camera is shown in flight In this photograph, the low finish and the pronounced downward tendency of the stroke is noticeable The photographs on this and the opposite page, together with a careful study of the text will be of assistance to both the occasional and the consistent golfer

THE "SHIMMY" IN TOYLAND

All of the toys illustrated in the photograph are caused to execute a peculiar dance by means of a mechanically driven wheel that is mounted off-center

A TOY FISH THAT SWIMS

The "fish" shown above, both in the water and in the boy's hands, are cleverly articulated and can be made to swim through the water in a most life-like manner

The Development of Childrens' Toys

American-made Toys Have Ushered In a New Era of Instructive Recreation

By Elizabeth Banks

BEFORE the World War, the majority of toys sold in the United States were imported and those that were made here were mere by products of other industries Then the supply of foreign made toys decreased and American "big business" stepped in to provide the children of this country with playthings So satisfactory were the results that the toys made here are now popular in other countries and the exporting of them has developed to a point where, for the first six months of 1925, the exports exceeded the imports.

One of the notable features of the growth of the toy industry in the United States is the increased demand for quality toys No longer are our children satisfied with flimsy affairs that are very pretty to look at, but which soon fall apart They demand toys that are sturdy and above all, lifelike The toys must last, even when subjected to the hardest use. In order to meet this demand on the part of the children, American parents are now spending more money for toys than any other people in the world and are getting quality products The result is that the toy industry in this country is growing by leaps and bounds and the children are getting what they want—toys that can really be played with, that are replicas of things used by grown ups, and, more important to the parent, but little realized by the child, that are instructive

Good Toys Must *Do* Something!

The child of today wants to be more than a mere audience with his or her toys. It is not sufficient to sit and watch the toy but there must be an element that allows the child to participate in the action and so, possibly, become an actor in some little drama of childish concoction. One outgrowth of this desire is the appearance on the market of toys that the child has to assemble These take various forms, ranging from sets of wooden dowels and perforated disks to highly elaborate outfits which supply numbers of steel girders, bolts and nuts, I beams, motors, gears and other items that lead the owners of the sets to attempt to duplicate, in miniature, the work of structural engineers With toys of this type, the child not only amuses himself, but with the aid of a guiding hand and a few words from the parent, gains knowledge of a practical nature.

Every parent knows that boys like to make things One answer to this urge is the mechanical toys just mentioned There is also the boy who has the desire to make things from wood Possibly this is one of the most instructive pastimes because the child must do all of the work himself, from the cutting of the raw stock to the finishing of the object In this case the need for good toys is very strongly evident One would hardly expect a carpenter to do work with a set of tools that cost a total of one dollar How then, can a child, whose knowledge of carpentry is limited, learn to handle tools that will not do the work that is performed by good ones? It is far better to supply the child with a set of tools that are made of good materials and are duplicates of the father's tools in every way except size Then, properly equipped, there is no reason why the boy should not learn the fundamentals of woodworking while he is at play The constructive spirit of the child will ever come to the surface and if allowed full sway, may soon show tendencies that will reveal characteristics which may shape the child's future life

A PRACTICAL TOY

This scroll saw, driven by an electric motor, can accomplish actual work with thin wood

Another toy that demonstrates the mechanical trend is the complete machine shop shown in one of the illustrations on these pages This arrangement is driven by a small electric motor and the toys so actuated operate in a surprisingly life like manner They can be used for light work Then there is also the power driven jig saw With this, intricate patterns can be cut and the child can exercise his or her ingenuity in devising puzzles and so forth.

Toys That Have Personality

The psychological advantages of properly designed and constructed toys are not overlooked by our educators. They have made studies of play and its complement, toys, fitting the toy to the moral and social needs of the child of every age. Toys may be selected from carefully graded lists which they have compiled For the age when the gratification of the child's sense of touch or hearing is all that is required of the toy, rattles, balls and other so-called "cradle-toys" are cited. For the "cuddling age," stuffed animals, such as the Teddy bear, the elephant, and soft body dolls are recommended. So the lists go, through the period of the toy and into the "sports" age

These lists are as useful to the retailer as to the parent, since they enable him to handle intelligently the request for a toy for a boy nine years old or for a girl five years old. They advise not only as to the general type of toy, but specifically as to size, color, and weight They also take the season into consideration As surely as spring brings the hurdy-gurdy, so it brings marbles and kites, so summer ushers in the toy sailing boats, and winter the sleds.

Our educators have further advocated that toys be bought in related units. The child shapes his games after the activities of his elders, his toys should have the same relation to one another as their originals in the adult world. Can a girl who

IS SHE SCARED?

This little doll called Scarey Ann raises her hair when a lever in her back is pushed

has nine dolls but has neither a doll's bed nor a doll's chair play at keeping house? Shall a boy who has a horse and a sailing boat stage his play on the seashore or in the barnyard? Or perhaps he has a horse and a rooster for the barnyard, but the rooster is twice the size of the horse!

The value of toys in the physical development of the child has not been neglected. Indeed, the outdoor toy is almost exclusively an American creation. So obvious are the benefits derived from exercise toys designed for outdoor use that further comment is not necessary. As a nation we were sold on physical culture and outdoor recreation years ago. Recreational toys are more appreciated as our country villages grow into towns, and towns into cities and as barns, fences, trees and cabbage patches give way to sidewalks and carefully tailored lawns.

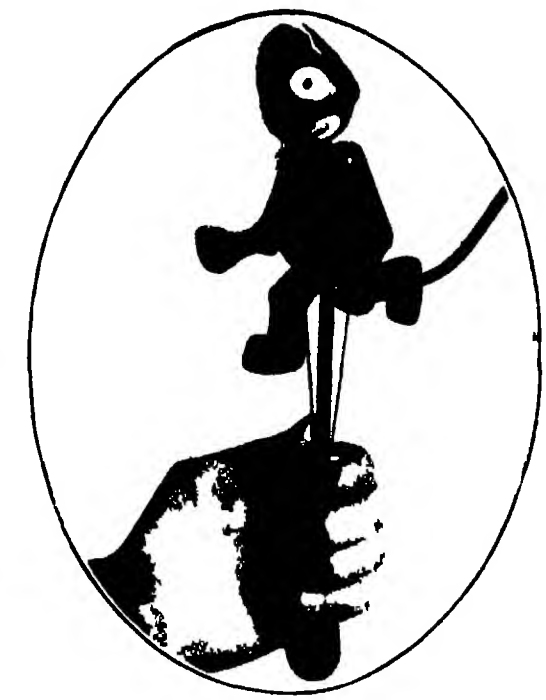
Did the American toymaker sense the appeal which something new has to the average adult and make a bid for success on that score or is he endowed by nature with inventive power superior to his competitors in foreign fields? Be that as it may the American toymaker has put more new toys on the market in the ten years of his ascendancy than Europe ever dreamed of. He gives personality to his toys. The Teddy bear although his pudgy figure was conceived in Germany, was given its name and popularized by an American, Seymour Eaton. Tommy Tinker and his associates are recognized joyously by the youngsters.

The American dolls have become known as character dolls. They illustrate particularly well the vigor with which the American manufacturer set about to capture the American toy market. The American doll had long been considered inferior to her German cousin, due to the fact that the making of the bisque head of the German doll baffled the American. Nothing daunted he developed his doll with an unbreakable head and soft body, gave it character, made his appeal to the children who want their dolls as nearly like real babies as possible and now the world clamors for the unbreakable "mama" doll. Raggedy Anne, Aunt Jemima, Rose O'Neil's Kewpies, and a host of cartoon character dolls, such as the Skeezix Boy, Little Orphan Annie, Felix the Cat, and Krazy Kat further illustrate this knack of the attachment of a personality to a product.

20,000,000 Dolls Annually

Indeed, the American doll industry warrants special mention, so amazing has been its development. Up to 1875, or just 50 years ago there was not a doll factory in the United States. Today the retail value of the products of the American doll factories is about 25,000,000 dollars annually. It is conceivable that the first doll made in this country is still treasured in a trunk of keepsakes in somebody's attic. If so, she should be feted on her fiftieth birthday! Imagination fails us when we try to picture such a party realizing that her descendants are estimated at 20,000,000 dolls a year.

To put and keep good toys in the American home has been the honest aim of widely differing types of persons. Educators have given their best. Our penmen have contributed much particularly to the individuality of the American toy. Progressive manufacturers have been receptive to ideas to be garnered from both these sources. They have kept their toys up to date and truly representative of the age in which we are living. Toy airplanes, toy submarines, toy vacuum cleaners, replicas of the inventions of our progress are on the market promptly—so promptly and in such detail that it is not an exaggeration to say that should the historian in the future have nothing but a collection



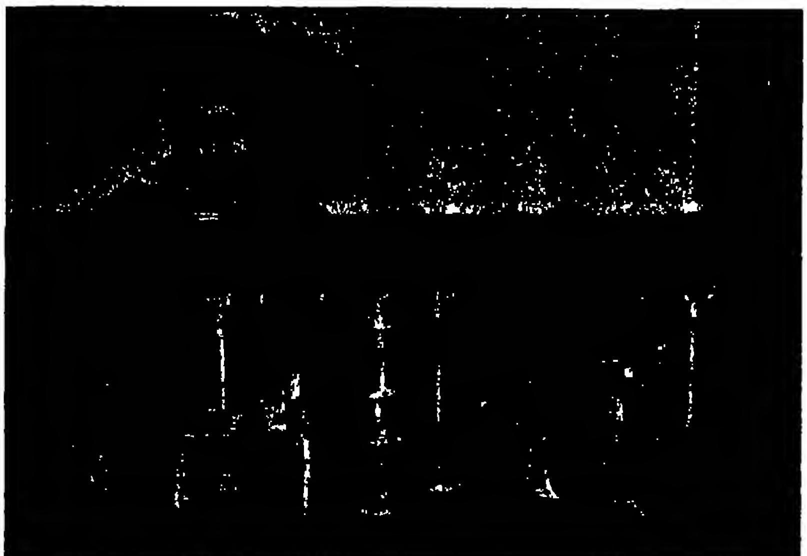
HE IS A GOOD RUNNER

Felix [illegible] the [illegible] as long as the [illegible] kept in motion

of our best toys he would be able to appraise our age with a fair degree of accuracy. Is our transition from the age of the horse drawn vehicle to the motor age more picturesquely told than in the passing of the hobby horse so naturally displaced by the toy automobile?

This embodiment of industrial and mechanical advances in the toys of our nation cannot be overlooked from an educational standpoint. Keeping the child abreast of the times and doing it in a manner that does not savor of compulsion is a serious problem that is in a large measure answered by toys. Our future engineers, scientists and world leaders are now in the home playing with toys. Will these help to fit him for the coming years? If properly selected they will do just that and some day the toy manufacturers will be able to chalk up other triumphs for their craft.

Elephants in Illinois! Not live ones, but something just as interesting—fossil remains that have an important place in history. The discovery will be described in an early issue.



Brown Brothers

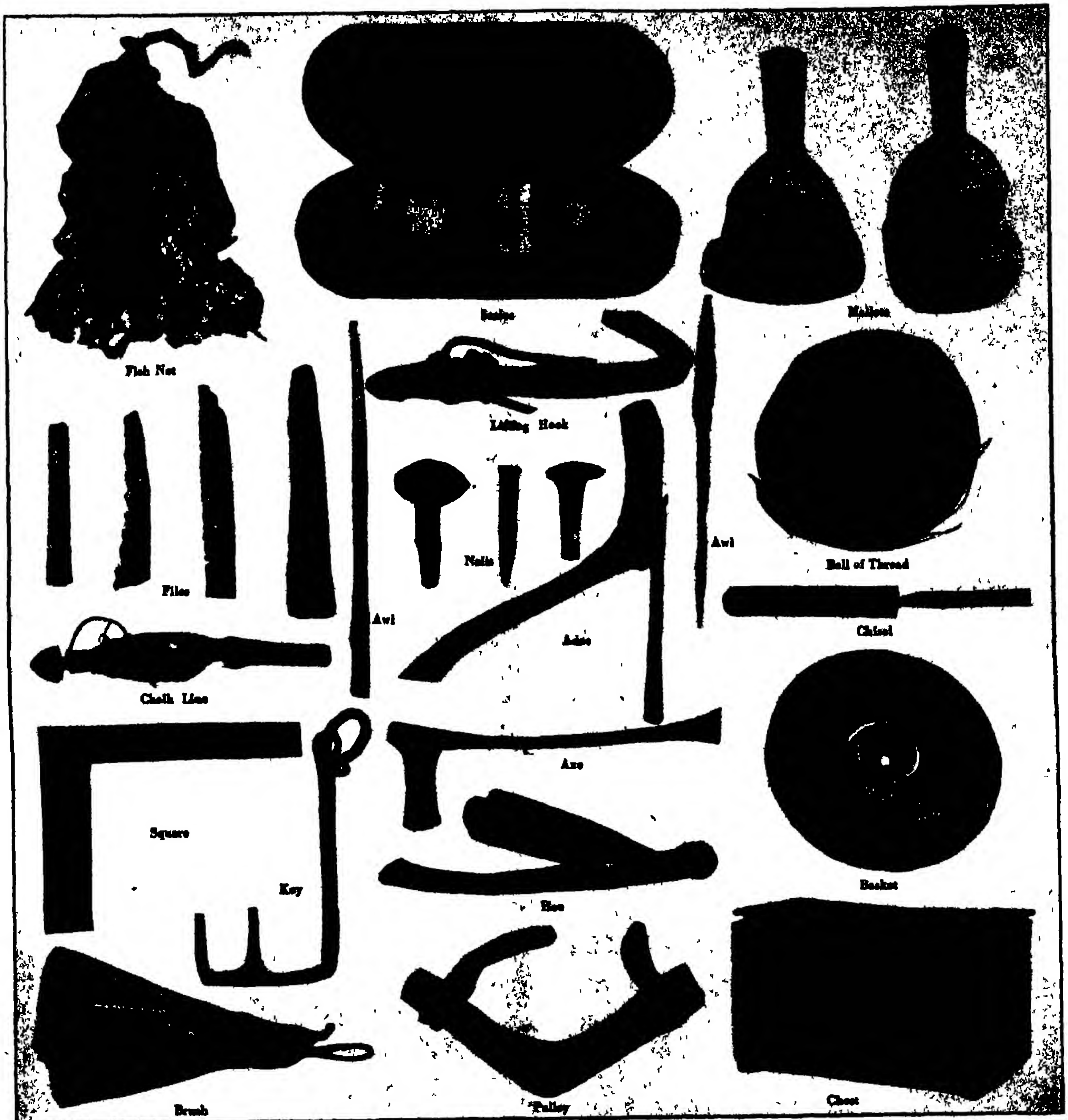
LEARNING TO RUN ALL KINDS OF MACHINERY

This young man is surely the envy of all the other boys because he is the proud owner of a complete miniature machine shop driven by an electric motor. The toys are exact duplicates of large machines in every day use

Brown Brothers

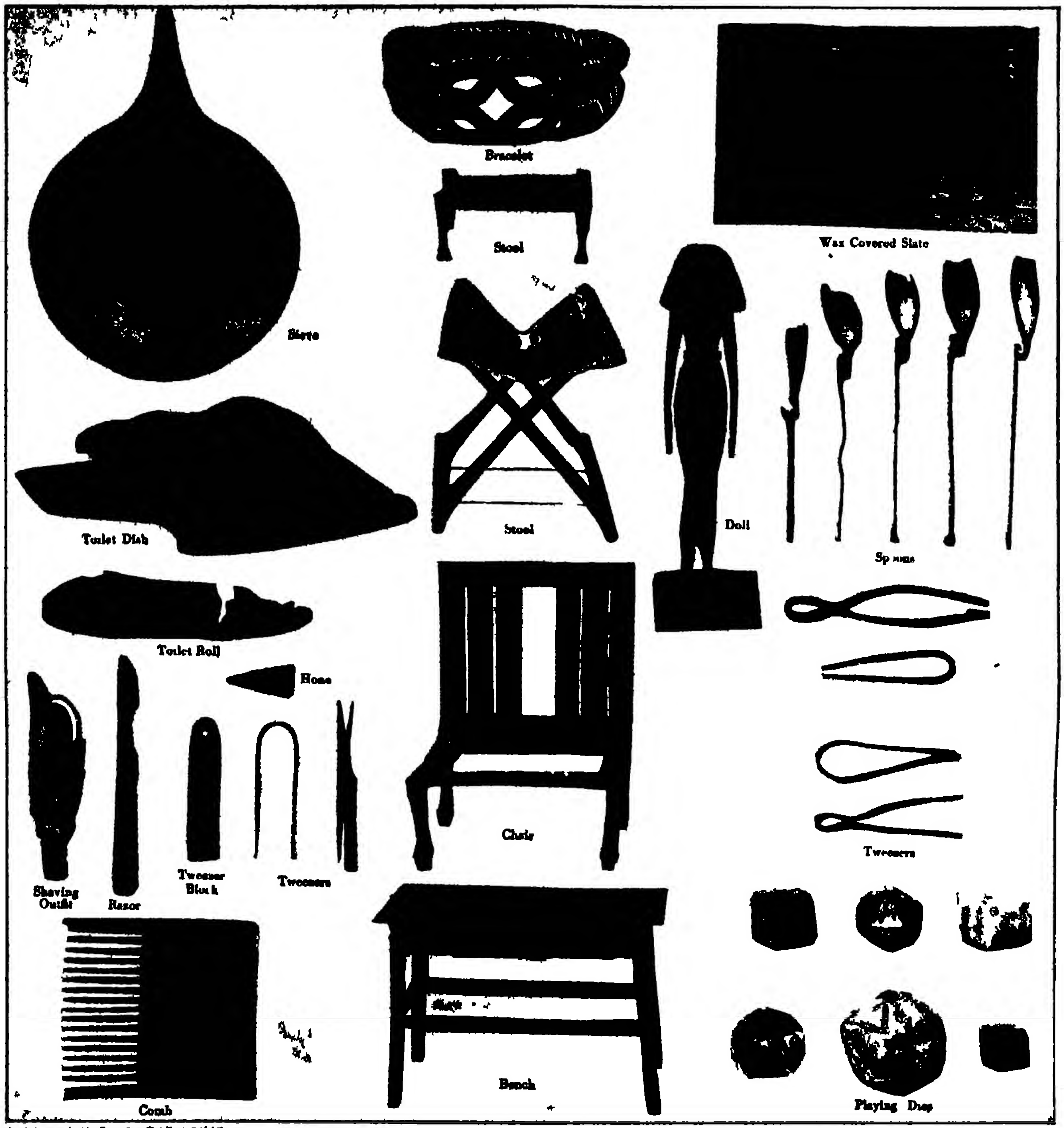
UNBREAKABLE TOYS OF QUEER SHAPES

With segmented figures of the type shown the child can amuse herself for hours. The animals can be twisted into all sorts of shapes yet they cannot be [illegible]. The joints are entirely flexible so that the parts are easily [illegible]



Tools and Household Implements of the Ancient Egyptians, Preserved by the Dry Climate, Now Show Us How They Lived

The monumental records and various works of art, and above all, the writings of the Greeks and Romans, have made us acquainted with their customs and their very thoughts, and although the literature of the Egyptians is slight, their monuments and the remains of the utensils that they used have been preserved by the dry climate and now afford us an insight into their mode of life The wonderful impetus given to archaeology by the recent discoveries in Egypt is one of the most interesting cultural events of the century We have already described the glories of Tutankhamen's tomb and we now pass to another interesting phase. How did the Egyptians live and work and enjoy themselves generally? We find that their lives were very much like ours, for their civilization was quite advanced for the remote period. It is difficult to visualize these conditions, but a visit to The Metropolitan Museum of Art in New York will go far toward shaping our ideas about these wonderful people. A number of years ago, Mr A. M Lythgoe, Curator of Egyptian Art, conceived the idea of having a series of cases devoted to articles used in the daily life of the



A photos copyright by The Metropolitan Museum of Art

Egyptians The exhibits have been gleaned from the excavation of ordinary sites which have brought to light a great variety of articles of every day use Of these, only some of the general classes need be enumerated—such as, for example, pottery dishes, vessels, and stone jars, knives and other implements of bronze and flint bronze needles and loom weights of limestone and Nile mud, weights of stone and bronze, measuring rods, articles for the toilet, bronze fishhooks and lead sinkers for weighting the fish nets, wooden tools, such as the hoe, the rake and the winnowing scoop, written documents, generally on papyrus, including letters, contracts and even medical recipes children's rattles, dolls, and toys, particularly in terra cotta, representing various animals, musical instruments such as the harp, and rush mattings which had been employed as floor coverings or door hangings many of them similar to those in use in modern Egyptian houses In another part of the exhibit we see scales like the old apothecary used some 75 years ago Here are mallets identical with those which stone masons and gold beaters are wielding in this very day Carpenters in ancient Egypt used the square and bricklayers the chalk line little improved today Some of their agricultural implements were excessively crude and their idea of a pulley is very naive We can imagine little Egyptian children scrambling for camp stools such as the one shown Paint powder and bobbed hair were all very much in evidence and there were parties where we have incontestable proof that little cubes were made to turn somersaults like our present day dice The coarse and fine toothed comb illustrated above also was an Egyptian invention

THE FORTUNES THAT WILL BE RETURNED TO UNCLE SAM

The figures on the cards indicate the amounts of money principal and interest that will pay off the various war debts

How the Nations Will Pay Us Their War Debts

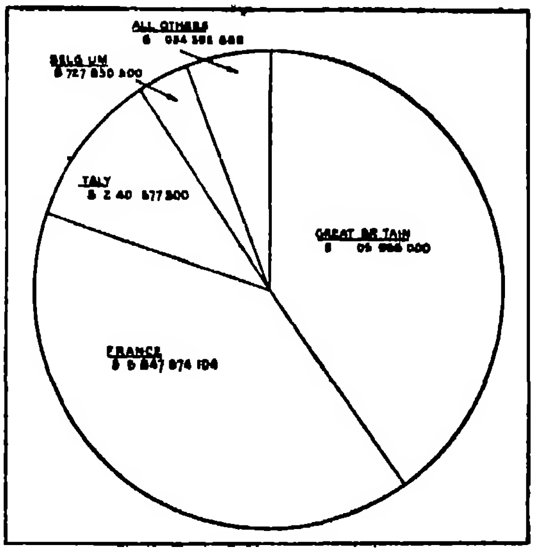
PERHAPS the relation of the United States to the debtor nations was never more happily put than in President Coolidge's Memorial Day speech at Arlington. The President referred to the loans made to foreign governments and foreign enterprises for the purpose of re-establishing their public credit and their private industry. He said:

By such action we have not only discharged an obligation to humanity but have likewise profited in our trade relations and established a community of interests which cannot be but an added security for the maintenance of peace. Insofar as we can confirm other people in the possession of profitable industry without injuring ourselves we shall have removed from them that economic pressure productive of those dissensions, discords and hostilities which are a fruitful source of war.

It has been in accordance with these principles that we have made generous settlements of our foreign debts. The little sentiment of 'live and let live' expresses a great truth. It has been thought wise to extend the payment of our debts over a long period of years with a very low rate of interest in order to relieve foreign peoples of the burden of economic pressure beyond their capacity to bear. An adjustment has now been made for all these major obligations and they have all but one been mutually ratified. The moral principle of the payment of international debts has been preserved.

Every dollar that we have advanced to these countries they have promised to repay with some interest. Our National Treasury is not in the banking business. We did not make these loans as a banking enterprise. We made them to a very large extent as an incident to the prosecution of the war. We have not sought to adjust them on a purely banking basis. We have taken into consideration all the circumstances and the elements that attended the original transaction and all the results that probably will flow from their settlement. They have been liquidated on this broad and moral humanitarian basis. We believe that the adjustments which have been made will be mutually beneficial to the trade relations of the countries involved, and that out of these economic benefits there will be derived additional guaranties to the stability and peace of the world.

'While we are thus desirous of the economic welfare of other countries in part because of its relation to world peace we ought to remember that our own government owes a great duty to the American people in this direction. It is for this reason in part that I have insisted upon a policy of constructive economy in the national administration. If we can make the circumstances of the people easy if we can relieve them of the burden of heavy taxation we shall have contributed to that contentment and peace of mind which will go far to render them immune from any envious inclination toward other countries. If the people prosper in their business they will be the less likely to resort to the irritating methods of competition in foreign trade out of which arise mutual misunderstandings and animosities."



ANOTHER PRESENTATION OF THE FACTS

Pie chart showing the distribution of debts under the debt settlements made with foreign governments

Now let us see what the nations have borrowed, with the amounts to be paid including interest. The terms of payment allow the debts to run over a period of 62 years and the total amount to be received by the Treasury, on account of principal and interest is as follows:

Belgium	$727,830,500 00
Czecho Slovakia	321,811,433 88
Esthonia	33,331,140 00
Finland	21,695,055 00
France	6,847,674,104.17
Great Britain	11,105,965,000 00
Hungary	4 693,240 00
Italy	2,407,677,500 00
Latvia	13,958,635 00
Lithuania	14,531,940 00
Poland	435 687,550 00
Rumania	122,506 260 05
Yugo Slavia	95,177,635 00
	$22,143,539 993 10

This is a tidy little sum even though we may have to wait a lifetime for all of it. Now let us see what the principal countries will pay the first year and the peak years.

Great Britain. Principal of debt (as funded) $4,600 000,000 interest $6,505,965,000, total $11,105 965,000. Initial year $161,000,000 peak year $187 250 000.

France. Principal of debt (as funded) $4,025,000 000, interest $2 822 675,104 17, total $6,847,674 104 17. Initial year $30,000 000, peak year $125 000 000.

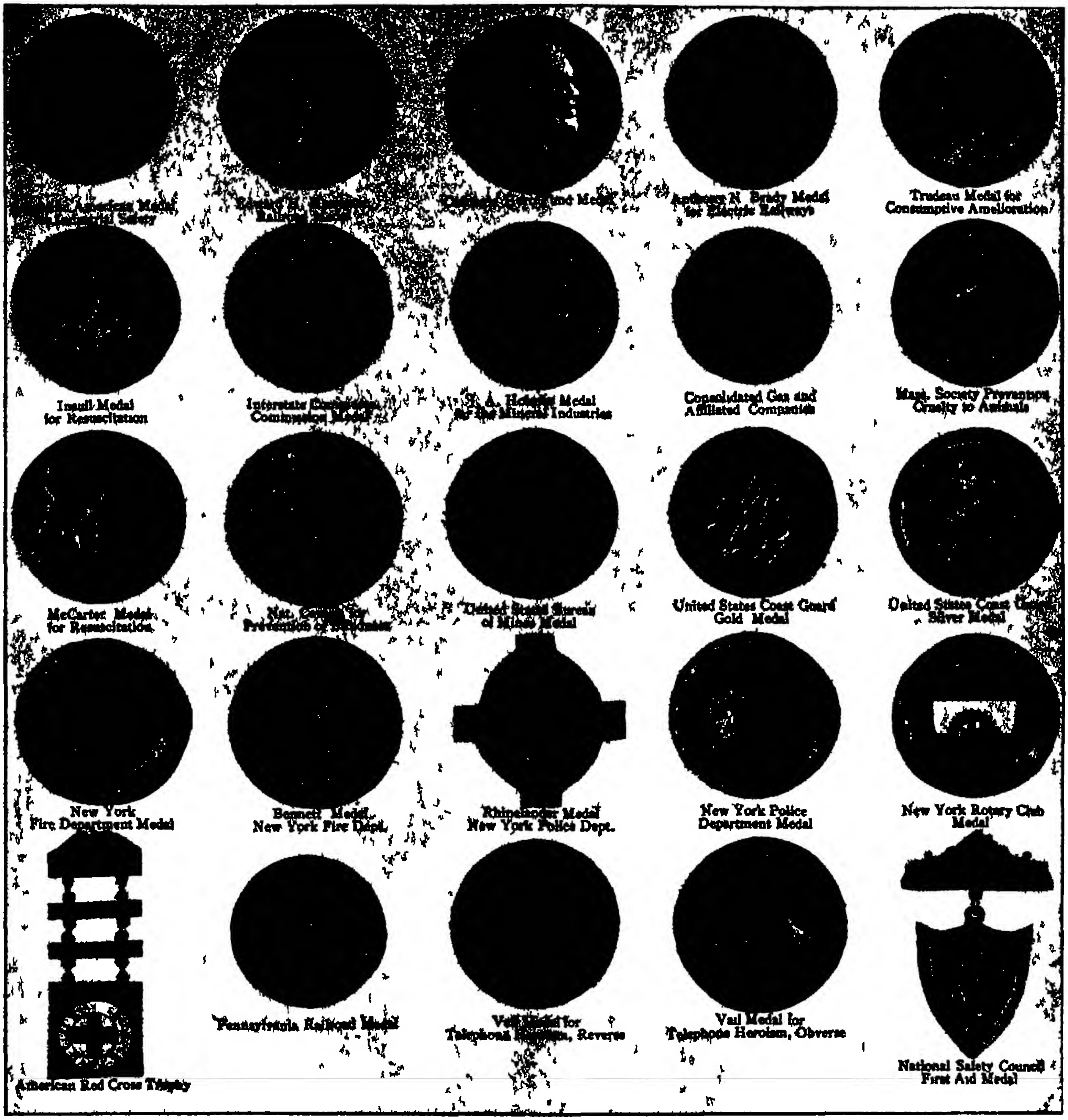
Italy. Principal of debt (as funded) $2,042 000 000 interest $365,677,500, total $2 407,677,500. Initial year $5 000 000, peak year $80,988 000.

Belgium. Principal of debt $417,780,000 interest $310 050,500 total $727,830,500. Initial year $3 640,000, peak year (1984) $12 868 000.

It would be tiresome to consider the other countries as the arrangements are practically the same.

So if, as the President said, we are not in the banking business we have been at least considerate, and we almost said have "tempered the wind to the shorn lamb."

In the detection of crime, bullets and guns can tell mute yet reliable tales when properly examined. Read about this latest development in an early issue of this publication.



Peace-time Medals for Heroism and Service

The "Scientific American Medal for Industrial Safety" has been awarded eight times by a Committee of the American Museum of Safety for safety inventions The 'Edward H Harriman Railroad Medal" is awarded for the promotion of safety on railroads The 'Carnegie Hero Fund Medal" is for notable cases of life saving The 'Anthony N Brady Medal" is awarded for safety The Trudeau Medal" is for the relief of consumptives The Insull Medal" is for resuscitation from electrical shocks The Interstate Commerce Commission Medal' is awarded to railroad workers The "Joseph A Holmes Medal' is for heroes in mineral industries The Consolidated Gas Company of New York and affiliated companies offer a medal A medal is bestowed by the Massachusetts Society for the Prevention of Cruelty to Animals The McCarter Medal for Resuscitation is in the gas field The National Committee for the Prevention of Blindness have a medal for services to the blind The United States Bureau of Mines awards a medal for bravery The United States Coast Guard bestows both gold and silver medals We illustrate several medals for heroes of fire and police departments The Rotary Club of New York awards a medal for conspicuous services to humanity The American Red Cross Trophy is given for emergency work The Pennsylvania Railroad Medal is for safety work The late Theodore N Vail created a fund for awarding bravery medals to telephone operators The National Safety Council's First Aid Trophy is a great incentive

A Flock of Unique Hybrids

Nature Plays a Curious Prank in Mating a Domestic Sheep and a Wild Ram

By Ethel W. Musgrave

IN an isolated section of southwestern Arizona, surrounded by barren desert mountains, lies the valley of Quijotoa Tall, forbidding cacti grid it about, jealously guarding its entrance. So remote is it from civilization and so uninviting in appearance that few have cared to visit it until the last two or three years, when it was discovered that here Nature had played one of her curious pranks and had created a small group of animals worth traveling many rough miles to see.

The old adage that the world will beat a path to the door of the truly great has been demonstrated in this instance, for many curious sightseers have followed the trail to this remote laboratory of Mother Nature's. Some have come away frankly puzzled, others have differed as to their opinions of the origin of the queer creatures they had seen. That they were the offspring of a domestic ewe was an assured fact, but the sire was unknown. Supposition has placed him everywhere in the category from a billy goat to a mule deer.

THE QUEER BROWN HYBRID

Its body is covered with brown hair instead of wool

So heated were the arguments, so rife the discussions, so varied the opinions that, three years ago, the news drifted into the office of a local representative of the United States Biological Survey. He immediately discredited a cross between domestic sheep and either goats or deer, but, desirous of securing scientific data, and bent upon satisfying personal curiosity, he undertook the rough trip to the Mexican border where he made a thorough investigation and returned the following authoritative verdict:

The animals are undoubtedly a cross between a domestic ewe and a mountain sheep—the only cross of the sort positively known to exist. Perhaps the coarse hair and the presence of a pair, or sometimes four horns, on the head of the sheep raised by the Navajo Indians on their reservation may indicate the same strain of blood. That, however, can be only conjecture.

The little group in Arizona was found to consist of one old unshorn ewe, the mother and grandmother of the line, a half breed ewe with a lamb, a magnificent ram, and, queerest of all, a dark brown creature with no vestige of wool but covered with coarse hair and equipped with a pair of dark, heavy, corrugated horns. All have well built bodies, sturdy, square feet, bright, beautiful eyes and a light rump spot, unmistakable marks of mountain sheep. The old ewe has undoubtedly mated with a mountain ram, for the entire line shows the same cross-breeding, a result both amazing and amusing.

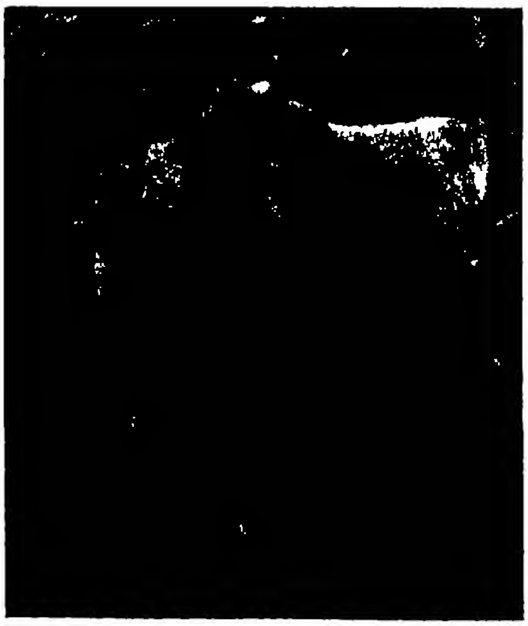
The first, and therefore the eldest of the hybrids is the half-breed ewe. Following a second mating with the mountain sheep a male was born, the handsome young ram referred to. The half-breed ewe has likewise mated with a wild ram, the result being the strange brown creature which is the most interesting of the flock because three-fourths of the blood coursing in her veins is of the wild strain. These three are certainly hybrids of the rarest sort. The group had increased, by last year, to twelve in number, but what the younger lambs are, none can positively say. They are, of course, hybrids, too, but whether they were sired by a wild sheep or by the young half-breed ram that is now grown and running with the flock none may know.

The origin of these strange creatures was pieced out from information gathered in part from "Old Juan," a Papago Indian, who, with his family, lives in this lonely little valley.

Years ago he selected a site on the bank of a stream created by the bubbling waters of a living spring. There in the shade of a huge willow tree he built a small house of adobe and proceeded to rear a family. The mother and the daughters worked in the garden, raising beans, melons and "chilis," while Juan roamed abroad, often going into the mountains of old Mexico, a few miles to the south, whence he brought home meat of the mountain sheep which were there quite plentiful.

Once or twice a year the entire family journeyed north to the little towns of Ajo or Gila Bend to buy supplies of flour, sugar and coffee to supplement their meager rations. It was on one of these trips that a man who was shipping sheep from that railroad point had given to the little Indian girl, Quina, a small lamb, an unfortunate little "leppy" or "bummer" forsaken by its mother.

That was the beginning of a period of faithful care and devotion. Through the long months that followed she watched with pride while the lamb fattened and grew. She often wondered why it had no horns like the small band of white nanny goats that, with a patriarchal old billy, belonged to old Juan. Quina's pet was turned out to graze with these goats, and when they went into the mountains and failed to return she trudged many weary miles across the desert to find them and drive them home. But that winter the girl went to a government school, and during her absence the animals roamed about as they chose, and were gone for weeks at a time. Juan knew that their favorite resort was on a mountain between his hut and Altas Tinajas (The High Tanks) or waterholes where the mountain sheep were so numerous, and where, it is probable, the strange mating occurred.



THE HALF BREED RAM

He was three years old when this picture was taken

Winter passed, and one day in late spring the lamb, now a full-grown ewe, came in with a wee lamb at her side. Quina was delighted, and, gathering the baby ewe into her arms, looked lovingly into its bright eyes. When, shortly afterward, she discovered the points of horns coming through on its head she thought surely the old billy-goat was its father.

The following spring both of Quina's ewes brought lambs, the older one a male, and the younger a female. The Indians thought this the funniest little animal they had ever seen with its coarse brown hair with the white patch in the rear and the horns that soon came. But Quina loved them all.

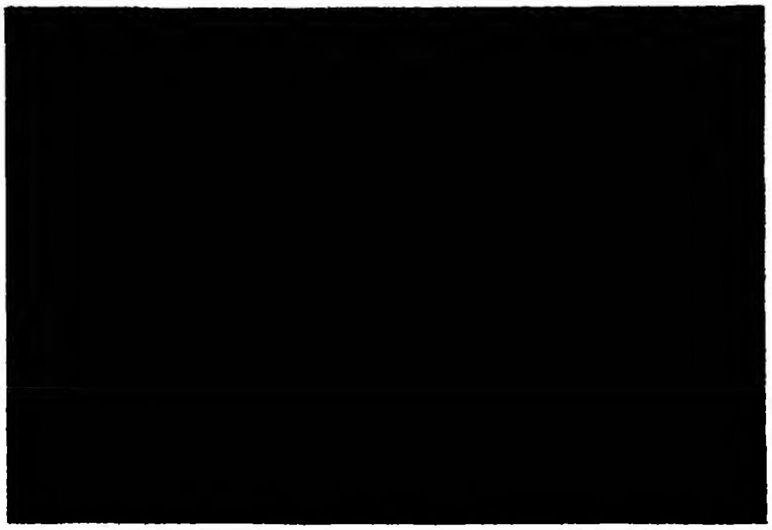
THE FIRST BORN HYBRID

She is on the left. Her second offspring is on the right

In fair English she tells of how a white man rode up to watch them as they drank in the cool brook while she sat nearby weaving a basket of yucca fibre. He admired her pets and delighted her by expressing the opinion that they must surely be part mule deer, because that animal has such heavy horns and also wears a light rump spot. Before leaving, he warned her that there was great danger of their being killed by coyotes, but the old billy goat and the young ram proved to be capable defenders of the flock.

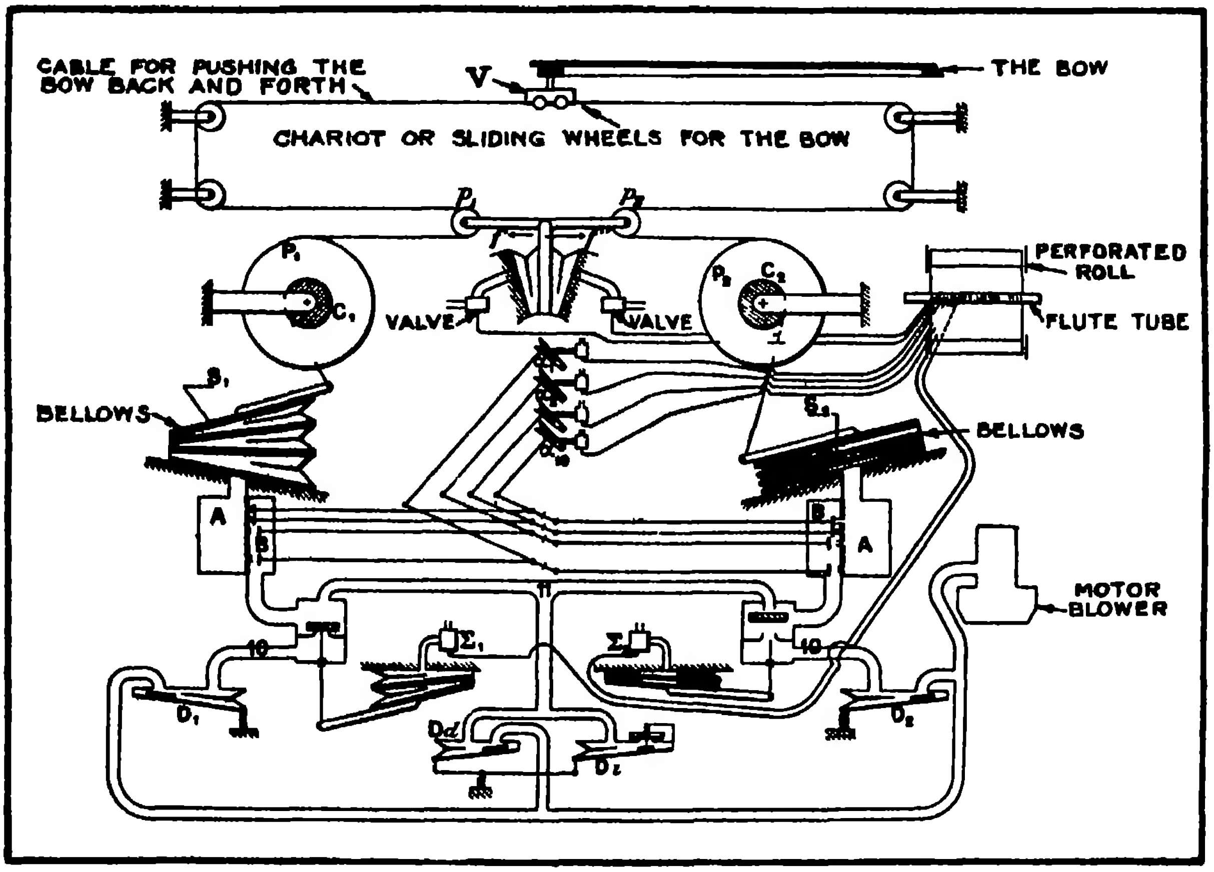
Many have visited the valley to see the rare animals whose fame is spreading rapidly, and a short time ago a patron of science wanted to purchase them as a gift to the state university. But Quina shook her head. "No want sell," she said. "Maybe take hund'ed dollar, one sheep." The sale was not made.

It seems inevitable, however, that some day they will be bought by someone who will perhaps place them in a private park where they will be under constant observation and where an accurate record will be kept of their increase. Even as this article is being written rumors are afloat that negotiations are under way for such a deal. Let us hope that these efforts are successful, for although a park may not furnish so picturesque nor so unusual a setting as was the valley of Quijotoa, it may mean the assured preservation of this group of rare hybrids.



A view of the "Violonista" with cabinet open to show interior mechanism

Top of the instrument, showing the position of the violin and the bow



How the "Violonista" is operated The small chariot, V, to which the bow is attached moves back and forth over the violin strings, being actuated by the cables passing over pulleys P and P_2 These are attached to the bellows S and S_2, through wheels C_1 and C_2 The air necessary for operation is fed to the bellows through the regulators D and D_2. Besides the latter and the electric blower, there are other auxiliary bellows and valves Dd Di E and F These regulate the pressure in the air reservoirs A B, A_1 and B The smaller bellows, a, a_2 and a control the action of the perforated music roll which in turn controls the operation of the artificial fingers and the bow

A Violin Played by Mechanical Hands

One of the intriguing problems that has held the attention of mechanical engineers for at least the last three centuries is the production of a device that will play a violin without the aid of human hands The photographs and diagram above illustrate the latest and most successful attempt but because of the intricacy of the proposition, it is interesting to review the work that has been done heretofore In 1627 in his 'Traite de l'hormonie Universelle," Father Marsenne mentions a device of German origin which was called the "Harpsichord' and which was purported to produce mechanically the sounds of a violin The apparatus however, was very crude and the best record that we have of an instrument of this kind that was really successful is that of the "Virtuosa" which was perfected in America in 1908 In this device, the fingering of the strings was accomplished by means of keys that were actuated by electro magnets The strings were set in vibration by one or more whirling disks that were brought in contact with them as required for the rendering of a musical piece This instrument was quite a success musically but from a mechanical standpoint it had several weak points Not the least of these was its short life Now we have the Violonista,' perfected by two Frenchmen Emile d Aubry and Gabriel Bareau The musical score for the Violonista is perforated on a roll of paper in much the same manner as that for a player piano The perforations control the flow of air and consequently the actions of the mechanical fingers and the bow The positions of the parts are shown in the photographs The violin proper is mounted on a series of hinges The mechanical fingering and the bowing is said to be nearly perfect

HOW THE PELTS ARE REMOVED

Many of the furs that are received by the establishment are not yet removed from the bodies. Therefore, a workman must be detailed for this purpose

WHERE THE SKINS ARE SORTED

At this point, the pelts are separated into two general classes consisting of the large and perfect ones and the smaller ones with slight imperfections

REMOVING THE SURPLUS FLESH

In order to prevent the spoiling of the skins by the decay of small bits of flesh and fat that might cling to them, this knife is used for scraping

SOAKING WITH A SALT SOLUTION

Skins are made soft and pliable by the liberal application of a solution of salt and water. The density of the saline solution is gradually reduced

How 50,000,000 Rabbits Furnish Milady's Furs

With the enormously increased demand for fur wearing apparel has come a corresponding decrease in the supply of natural furs of all kinds. Hunters and trappers have been unable to keep up with the demand for different kinds of animal skins and as a result, a new industry has sprung up. This has to do with the conversion of rabbit skins into fur garments and so manipulating the pelts during the curing process that the finished coat, neck piece or other article of wearing apparel will resemble one or the other of the various expensive furs that are now hard to obtain. The photographs on this and the opposite page show the more important steps in the process. The rabbit skins are first collected from various sources. Amateur and professional rabbit breeders contribute from their stocks. When the pelts arrive at the fur-converting establishment, they are sorted into two general groups, one containing the large and perfect pelts and the other the small and imperfect ones. These two grades go through different processes as will be described below. We will first deal with the large, perfect skins. A special knife is employed for the purpose of removing the last vestige of flesh from the back of the skin in order to give the pelt a perfectly smooth surface. The skins are then treated in a salt water bath to make them soft and pliable and to enable the workers to handle them easily. The strength of the solution is gradually reduced and after the pelts are stretched to their original sizes, they are washed thoroughly in water. Soap and a brush are vigorously applied in this step. The skins are now transferred to a so-called "fulling mill" where they are given a thorough rubbing and stretching. A sour bran bath now awaits and the skins are put in it. This is for the purpose of causing the pores to expand. After a few days, the pelts are removed, covered with alum and placed in revolving casks, which are kept turning until the furs are completely dry. In the

HERE THE SKINS ARE DRIED

After a layer of alum is applied to the wet pelts they are collectively placed in these revolving casks and tumbled until they are thoroughly dried

HOW OIL IS APPLIED TO PELTS

The second or inferior grade of skins are subjected to an oiling or greasing process during which olive oil or pork grease is rubbed thoroughly into them

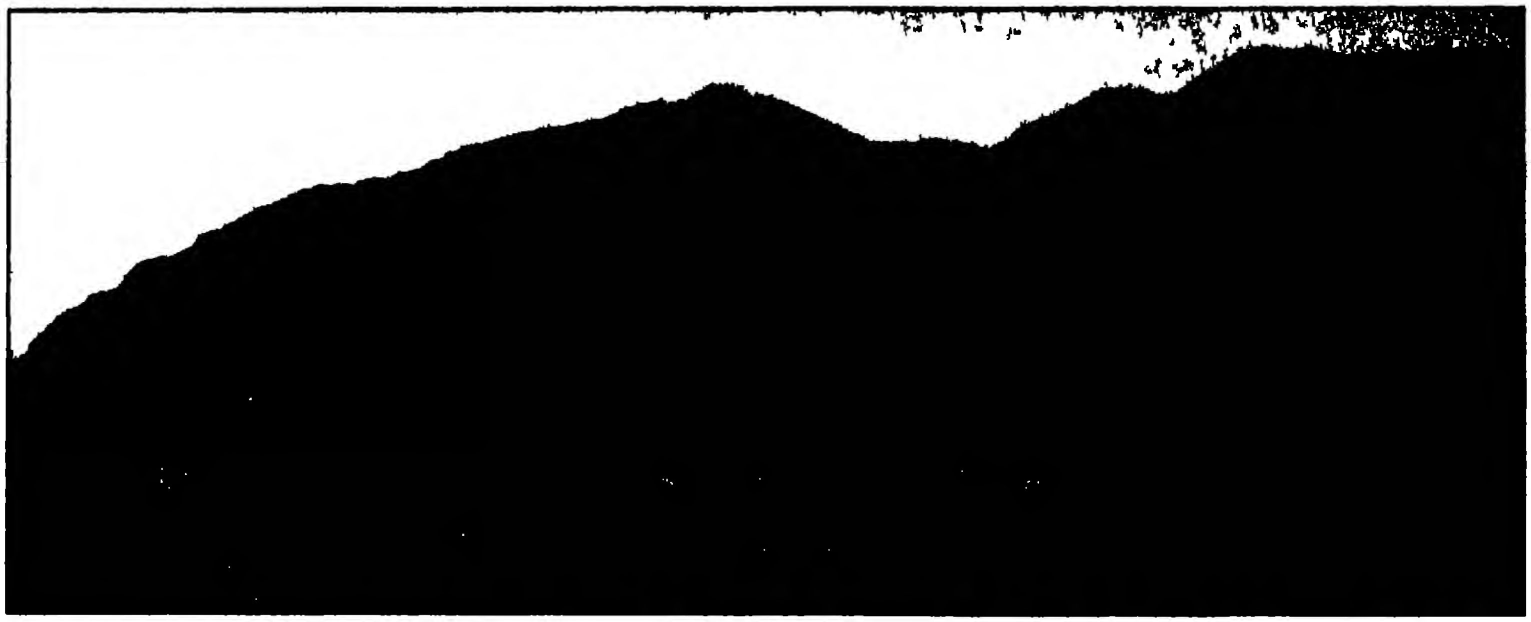
ONE OF THE IMITATION PROCESSES

This ingenious machine stretches the rabbit furs so that they lose their original shape and assume that of an otter skin. The value is thus increased

ONE OF THE FINAL STEPS

Cutting the cured and treated skins. Note the various forms and patterns from which the pelts are cut to the required shape for different garments

curing treatment for the lower grades of furs, the process, except for the "fleshing" or removal of the bits of fat and flesh that cling to the pelt, differs materially. After this has been done, the skins are sewed together in pairs and are then covered with either pork grease or olive oil. The fulling process is employed to completely saturate the skin with the oil or grease. In order to allow plenty of time for the absorption of the material, the pelts are allowed to stand for a few days. They are then stretched out to dry in the open air and in order to insure proper softening, they are subjected to a light beating with a rod. It is, of course, necessary that none of the grease or oil remain on the surface of the skin as the only place where these are wanted is in the pores. Therefore, the pelts are placed in the drying casks until the outer surfaces are completely free from oil or grease. Another softening beating follows and then steel combs are used to straighten the hair and smooth it out. This completes the curing process for both the high and the low grade pelts and from this point on, the treatments are practically identical. The next step is to impart a luster to the hair and to hide any defect in the pelt that might lower its value if detected. Machines are used in this "lustering" process. These systematically rub and brush the furs, working them into the best possible condition. During this part of the treatment a solution of alcohol, gum lac, glycerine, yolk of eggs and cotton seed oil is worked into the pelts. The furs are then trimmed out. They are now colored according to the name under which they will eventually be sold. For instance, to imitate leopard skin a solution of hyposulphite of soda is applied. Of course the texture of the skin, the length of the hair and the appearance of it enter into the determination of the type of skin for which the rabbit furs will be sold. After they are sorted according to these classifications, they are passed along to the camoufleur. Here, as mentioned above, they may be spotted to imitate leopard skin or they may be subjected to other treatments that will produce simulations of the hides of other animals. For one of these the operator shaves off the upper part of the hair with a specially designed machine. Following this the hair is touched up at the roots with a solution of alcohol and potash of soda. Any loose fur is then removed by beating.



THE MOST COMPLETE SET OF CHIMES IN THE WORLD

Situated on a hill overlooking Avalon Bay are the chimes. Daily their beautiful tones are flung out on the air to be heard five miles out to sea. They are made to strike the hours, half and quarter hours as well as to furnish musical entertainment

STANDING AS A BEACON FOR SHIPS AT SEA

The nocturnal illumination of the chimes is said to be of value to navigators of small boats who do not make landings before dark. The striking effect of the chimes and the lighted water front of Avalon Bay is vividly shown in the above photograph

The Chimes of Catalina Island

Located 230 feet above Avalon Bay on Catalina Island, and housed in a beautiful tower, a set of chimes issue forth a welcome to each incoming passenger steamer with its freight of vacationists. On the departure of the vessels, the melodious tones send their farewell notes out over the sea, chiming *au revoir*. The chimes are played in accompaniment to the nightly concerts of the Catalina Marine Band in the Greek Amphitheater, located a mile distant across the lovely cove where the picturesque city of Avalon is situated. With the striking of each hour, half and quarter hour the chimes peal forth their musical chords. At vespers they are used for a special musical service while on festive occasions a program of selected numbers is played from the console located in the offices of the Santa Catalina Island Company. Not only does the beautiful sound penetrate five miles out to sea, but via radio the chimes are flashed into the ether through radio station KFWO. Here was one of the most difficult problems which confronted the installers—that of successfully harnessing the tones so that they could be effectively transmitted out into space—but it was solved. Mr. J. C. Deagan, master inventor of percussion musical instruments, states that these chimes are the most complete set in the world. There are twenty tones, D to A, chromatic. A three horsepower motor and 45 volt generator are located in the chimes tower to operate the bells. It took more than three years to construct the specially designed clock and electrical devices which operate the tubular bells—and it took ten years to make the great tubes themselves! The automatic clock operates the chimes every fifteen minutes during the day, and in addition there are two complete sets of keyboards, or consoles, from which the musical tones can be controlled. Nearly ten miles of wire were required to connect the chimes with the consoles—one located in the offices and the other in the Greek Amphitheater. When the bells were ordered, it was distinctly specified that their tonal qualities be soft, musical and free from any harsh metallic qualities. To achieve this meant special testing—month after month of painstaking experimenting during which time 94 alloys and more than 100 different wall and diameter proportions were considered before the ideal of perfection was secured. Then came the problem of atmospheric conditions at the island. The long steel tubes were to be subjected to sudden changes of temperature from the sea air and from the heat. This situation involved considerable testing, and difficulty was encountered owing to the expansion and contraction of the metal, which affected the tonal quality. Unlike cast bells, these chimes make possible extreme accuracy of tuning, even intonation, and uniform volume, carrying capacity and tonal characteristics throughout the entire register, no matter at what distance the sounds are heard.

How Washington's Garbage Pays Dividends

Efficient Disposal Plant Reclaims Valuable Oils and Greases

By Nell Ray Clarke

THE lowly garbage pails of the District of Columbia have been furnishing one of the principal ingredients of a brand of toilet and bath soap widely advertised for its purity. At the same time they are yielding a revenue to the United States Treasury of between 50,000 and 75,000 dollars annually. Three fourths of this sum goes back into the District appropriation, in accordance with the plan for financing affairs, but the other fourth helps to pay the salaries of the President, the postman and the prohibition agent.

The plant which reduces the garbage to oil or grease is an old one, but it yields a better quality of reclaimed material than any other plant in the country. Soap and candle manufacturers offer a premium on its product. The set up is known as a modified Chamberlain system for the reduction of garbage. The collected garbage is cooked for eight hours and then is put under hydraulic presses and all the grease squeezed out of it. The principal constituents of that grease—stearic acid or stearin, and a little glycerine and red oil—are used in the making of soap and candles. In spite of the fact that the idea is a little revolting, the product is perfectly pure after having been cooked in live steam for such a period of time.

When the garbage men have collected the contents of the family swill buckets in their covered trucks, they dump it into the seventeen 55- to 60-ton gondola cars, each of which carries about 1,950 cubic feet of garbage. The cars steal out of Washington at night, down to the reduction plant at Cherry Hill, Virginia, 30 miles south of the city. There they are shunted off on a siding that runs beneath a platform of the mill.

Over 50,000 Dollars Profit

A grab bucket hoist mounted on the platform lifts the green garbage, as it is called, up to a receiving tank on the second floor level of the building. On the first floor of the building there are 24 digesters which look like tall boilers on end. They measure six feet in diameter on the inside and are 14 feet high, extending up above the second floor level.

On its way from the receiving room the garbage is superficially searched for tin cans, bottle tops, pieces of crockery, glass and other substances which might do material damage to the machinery of the plant in some of the later processes. It is then shoveled into the big boilers by way of an opening near the top. The door is then clamped shut and live steam under about 75 pounds pressure is turned on the garbage. This enters the bottom of the tank and percolates thoroughly through the material for eight hours.

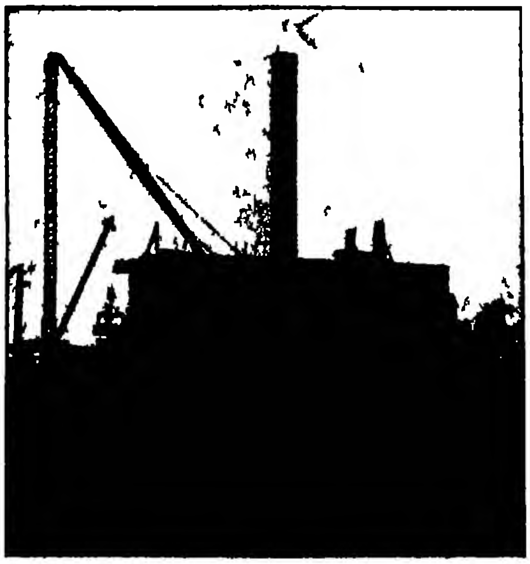
At the end of that time the steam valve at the bottom is turned off and as much water and grease drained off as possible. Then steam is turned on from the top of the tank, the down pressure of which drives out all the liquid in the cooked garbage and leaves only the solid mass, which looks like spinach. The doors to the digesters on the first floor are opened and the garbage is pulled out into a conveyer, consisting of a wooden trough through which a chain moves. The conveyer chain, equipped with scoops, runs beneath the digester and drags the cooked garbage out toward the presses.

A little flat truck, on top of which rests a rack made of thin, green wood like the laths used for plastering, is run up under the conveyer, a board is slipped out of the bottom of the trough, and the conveyer chain scrapes the garbage onto the rack which has been covered with a sheet of press cloth about five feet square.

The press cloth incidentally is one of the most expensive items in the cost of running the plant. It is made of cord about one sixteenth of an inch in diameter woven into meshes about one tenth of an inch apart, and permits the grease and water to pass readily through its meshes. It is easily torn in the huge presses by the tin cans, bottle tops, glass and broken crockery which the thoughtless housewife dumps into her garbage pail.

The four corners of the press cloth are then wrapped over the garbage and another rack is placed on top, another press cloth placed on top of that and more garbage dumped on until the pile becomes about six feet high. The car is then pushed on rails beneath a ram, and gradually the great arm of the press pushes the little truck with its odoriferous burden upward against the flat top of the press.

The plant is now using 12 hydraulic presses under 4,000 pounds pressure per square inch, or 300 tons pressure per press. They are built to produce 6,000 pounds to the square inch, the difference representing the margin of safety. In order to get this high hydraulic pressure, a duplex steam pump with 16-inch diameter steam pistons and 1¾-inch water pistons is used.



WASHINGTON'S GARBAGE REDUCTION PLANT

Two gondolas are shown loaded with garbage which is being dumped from the bins to the second floor of the building

The grease and water trickle out into a trough beneath the press. This trough leads to a series of concrete tanks arranged in tiers. As the mixture cools the water settles to the bottom and is drawn off from beneath and the grease is dipped out by means of a perforated pipe which must be held on the surface of the liquid.

At one time the residue from the process, or the press cake, as it is called, was thoroughly dried in a separate drying plant and sold for fertilizer, but the process employed necessarily increased the fire risk to a grease-saturated plant. At that time, fires constantly broke out at the plant and did a great deal of damage. In addition the fertilizer had to be stored until a suitable market could be obtained for it.

When the bottom dropped out of the fertilizer market, several years ago, the drying was discontinued and the press cake is now used for fuel for the furnaces of the plant itself, with the result that the operators have saved 30 percent of their coal bill, which incidentally amounted to more than they could have received for the fertilizer at the present reduced prices.

During the last fiscal year 72,927 tons of garbage were collected in the District of Columbia. Of that amount 69,392 tons were reduced, some of the collection having been sent to Blue Plains, the Home for the Aged and Infirm of the District, to be used for pig feed, and some of it being thrown away for various reasons. The 69,392 tons produced 3,629,875 pounds of grease which sold for $250,049.44. The cost of production was $191,923.67, which included transportation of the raw garbage, the running of the plant, labor, replacement of worn out machinery and other repairs.

This saving of more than 50,000 dollars was effected in spite of the fact that the plant is now more than 25 years old. In peak years, the saving has exceeded 70,000 dollars. In all justice, it should be said, however, that the cost of collecting the garbage is not included in the cost of running the plant. If it were added the sale of grease would just about cover that item also, without showing any margin of profit. The District officials realize, however, that the collection of refuse is a sanitary measure and must be attended to no matter how the garbage is disposed of.

Why a Profit Is Realized

The depreciation in a plant for this kind of work is necessarily very great, as the ammonia in the garbage eats away the piping, but since the District's plant is such an old and inexpensive one, the total is not as great as it would be in a modern plant where the original outlay for machinery was great. The huge digesters of the plant formerly wore out completely in three years. Within recent years they have been lined with a glazed tile which has increased their life more than four times that long—in fact about 14 years. For further economy, brass pipes in the boilers are to be tried.

District officials are somewhat puzzled as to why its garbage reduction plant makes money when so many of the more up-to-date plants run into debt. In the final analysis they believe that the success of their method must be due in part to the able managership of Mr. J. G. Crane, an engineer of extraordinary ability who designs much of the required machinery, and in part to the fact that more garbage is collected per capita in the District of Columbia than in any other large city in the United States. Washington has almost no foreign population. As a rule it has been found that immigrants are very frugal; they use every available part of fresh vegetables and meats, while our colored brethren in Washington are as wasteful or even more so than the wealthiest white families. For instance, one garbage collection wagon in the white district of Washington will cover as much territory as three wagons can cover in the colored district.

Naturally the plant is no place for a pleasure tour. One makes no mistake about knowing when he has arrived at the plant or even in its vicinity. Every part of the plant and even the earth around about is reeking in grease. But there is certainly romance in making 70,000 dollars a year out of something which the housewife insists shall be taken out of her backyard.

From the Scrap-book of Science—Camera Shots of Scientific Happenings

International Newsreel

SCIENTIST GRANDSON OF THE GREAT HUXLEY

Julian Huxley of the Department of Zoology Oxford University, recently told the assembled members of the British Association for the Advancement of Science how some of the lower animals conduct their courtships Male birds, crabs spiders and other animals display their attractions before the females, he states This implies a belief in sexual selection Today most scientists have given up sexual selection. This has misled many anti-evolutionists into falsely thinking that scientists are giving up the established principle of evolution itself

P & A Photo

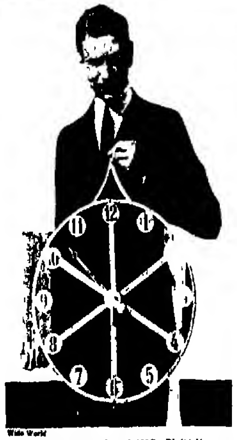
CALIFORNIA BUILDS VEHICULAR TUBE UNDER ALAMEDA ESTUARY

Twelve reinforced concrete tubes having a thirty-two foot bore and weighing a total of 4,500 tons are being built at Hunter's Point, California for the vehicular tube which will connect Oakland with Alameda under the Alameda Estuary The tubes are being made in drydock, floated nine miles and placed The total cost of the job will be nearly 1,000,000 dollars

P & A Photo

SHIPS GET WEATHER MAPS BY RADIO

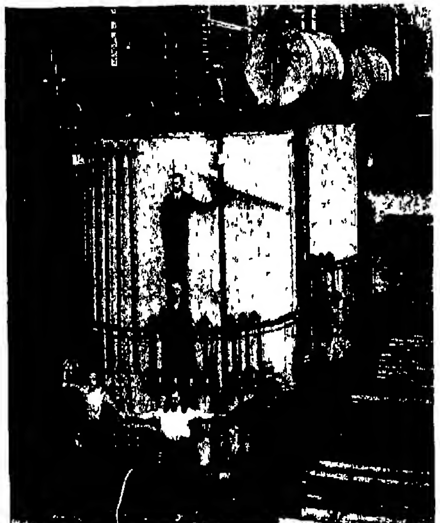
C Francis Jenkins, of Washington, D C., has developed an apparatus by means of which ordinary weather maps, such as those regularly issued by the United States Weather Bureau, are transmitted to ships at sea In the picture Edgar B Calvert, Chief of Forecast Division, United States Weather Bureau, is receiving maps transmitted by this method



Wide World

PORTABLE FOLDING CLOCK

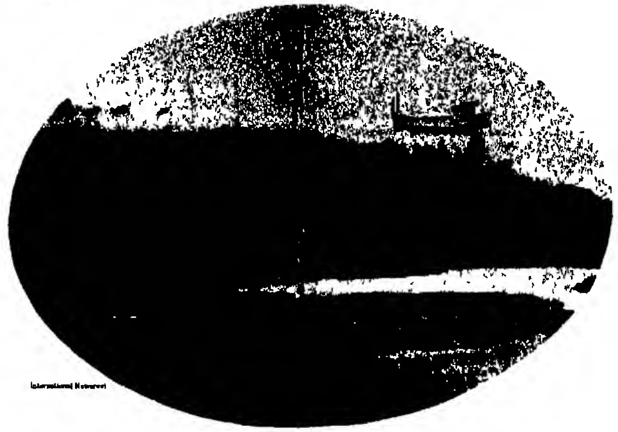
This clock whose hands are driven by an ordinary 'dollar' watch, may be folded up and tucked away in the box carried in the inventor's hand Its diameter is two feet



Courtesy General Electric Company

LARGEST SINGLE PHASE TRANSFORMERS

The over-all dimensions of each of these gigantic units are height 23 feet 11¼ inches, length 15 feet 7 11/16 inches, width 12 feet 5 7/8 inches The total weight of each is 202,200 pounds—more than one hundred tons—of which the oil weighs 79,000 pounds Each unit has a capacity of 28,866 kilovolt-amperes —nearly 40,000 horsepower—at 60 cycles



International Newsreel

AIRPLANE CONQUERS MALARIA

The United States Department of Agriculture has been making experiments with the distribution of Paris green from airplanes, as a control for malaria mosquito larvae In the final tests more than 99 percent of the larvae were destroyed when the poison was dusted over swamps and mosquito breeding areas A government circular on the new method has been issued

Wide World

LANDING THE END OF AN OCEAN CABLE

A new cable across the Atlantic from New York has been added to those already in use The new one will, however, do the work of several of the old since it is enveloped with a continuous spiral wrapping of permalloy, an alloy consisting of 78 percent nickel and 22 percent iron This alloy adds to the permeability of the cable to magnetic flux This in turn permits signals to be flashed along the cable at much closer time intervals than previously

Kadel & Herbert

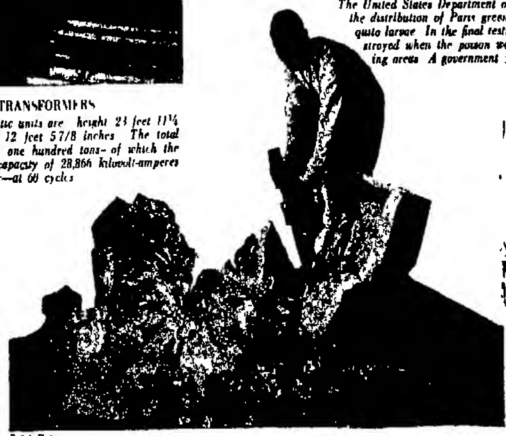
PLASTIC MOVIE FILMS

Two German inventors claim to have produced a seemingly stereoscopic film

Wide World

TYPEWRITER THAT WRITES IN CHINESE

Tse Quon of Shanghai, has produced a typewriter that writes large numbers of the Chinese ideographs First a single key arm drops down and picks out the desired character When used it is automatically dropped back into its original slot The machine writes 5,700 different Chinese characters and weighs 76 pounds



P & A Photo

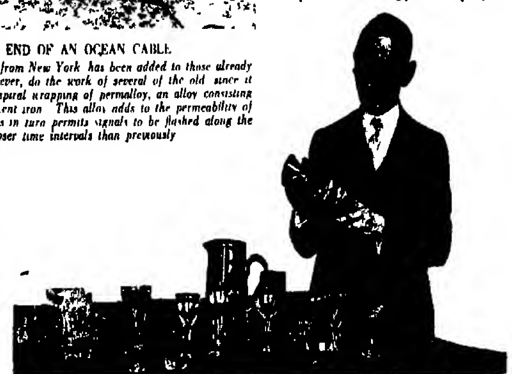
A COOLED POT OF OPTICAL GLASS

At the United States Bureau of Standards, Washington, D C., optical glass of excellent quality is made for scientific purposes When the World War came America discovered its dependence on Germany for this necessary material Germany knew how to make it, we did not But after some little research a way was found

P & A Photo

FILMING THE GROWTH OF PLANTS

When next you see a moving picture of a plant growing, with its leaves waving about as if in a wind, think of this picture The camera is geared down in such a way that single exposures are taken at given, equal intervals When these are run through rapidly the slow growth becomes perceptible, plainly showing the various stages



P & A Photo

UNCLE SAM TESTS BEFORE BUYING

Before purchasing glassware to equip government owned ships samples of the various kinds of glass were sent to the United States Bureau of Standards for careful test Those who visit Washington should not miss the Bureau, where innumerable tests and experiments are continually going on The Bureau is supported by the Government

A new convenience for men

A Hinged Cuff Link

THE new type of cuff link illustrated above is provided with a hinge in the connecting bar which makes it possible to pull the hand through the cuff and to raise the cuff on the arm without removing the link

Cutting Square Holes

THE lab r saving tool shown in these columns is useful for making holes for switch boxes It cuts plaster and wood without damaging the walls or wallpaper First it is fastened to the wall by two screws and is then operated by an electric drill or hand brace The right hand illustration shows the protruding circular saws

Preserving Anti-skid Grooving

PRESERVING the anti-skid groove on a solid tire tread is a matter of practical importance The regroover shown comprises a holder containing a knife and has a handle to guide the cut across the tire tread Connected to the regroover is a heavy duty high speed electric motor which drives the regroover knife through the rubber at a rapid rate The knife is of V shape so as to give the proper form of groove and is so regulated that it always cuts to the same depth Two knives are provided for different depths of groove The tool is so designed that the knife receives 3000 impulses a minute

Solid tire re-groover

This tool cuts square-corner holes for switch boxes

Traveling Bag Clothes Hanger

THE gentleman in the photograph is folding his suit over a fiber form preparatory to putting it in his traveling bag When he arrives at the end of his journey he will take the suit out with one motion and hang it in the closet It will be free from wrinkles Valet service can be supplied in most hotels but this saves the expense

Keeping the clothes pressed

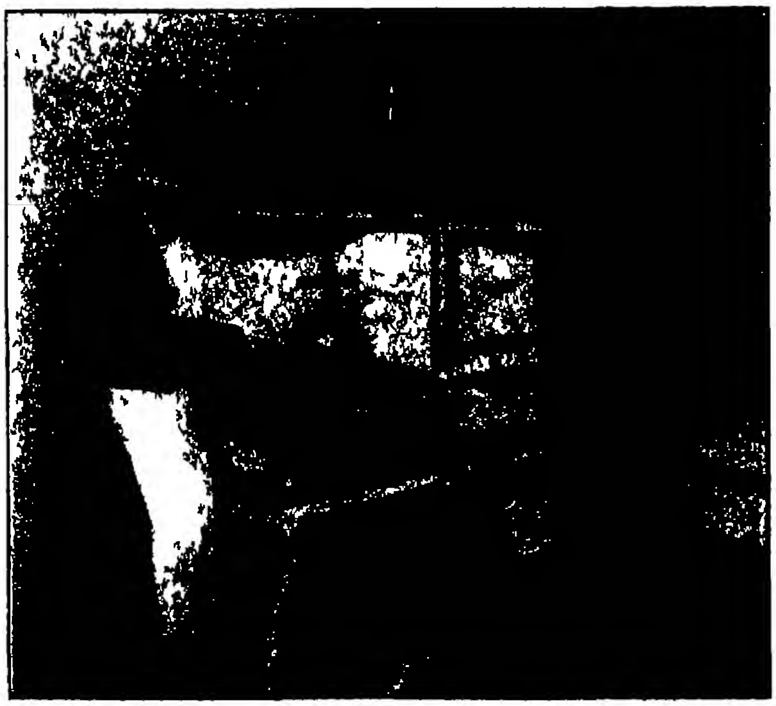
Paper Making in Miniature

WE reproduce a photograph of a miniature paper machine which was made in France The construction of the machine was begun in 1902 and finished in 1914 The device received a silver medal at the Lyons International Exposition It is a complete paper-making machine in every particular It will make a sheet of paper four inches in width and of any desired length depending on the amount of pulp which is fed in at the "wet end" of the machine

Miniature French paper machine makes a sheet four inches wide

A Kitchen Cabinet for the Kitchenette

THE combination of a kitchen cabinet and gas range marks a new era in gas cooking equipment The food compartment cannot become warm as it is insulated by heavy asbestos The principle of cool air circulation has also been applied A tremendous number of steps will be saved in the kitchen by combining these two necessary articles in small kitchen equipment



This kitchen cabinet forms part of the gas range

A semi-automatic ice pick

An Economical Ice Pick

AN ice pick that chips ice without waste is illustrated partially unassembled The weighted handle sliding on the blade, acts as a hammer to drive the point into the ice The pick is carried back after a blow is given, by the spring within The pick will not roll if placed on a table as one side of the handle is flat

Fire Kindler Burns Twenty Minutes

THE illustrated brick of pine chips pine oil and rosin is designed to eliminate the use of paper, kindling wood and oil and is particularly valuable for campers who may not be able to obtain dry wood It can also be used in gardens and orchards or for general singeing purposes and also for basket incinerators To use the kindler simply light it and place it flame down at the bottom of the grate or in the middle of the fire to be built Then add lump coal or logs in the usual quantity and a brisk fire is assured The kindling brick burns for twenty minutes

Pine chip fire kindler

A Convenient Magnifying Glass

A NEW YORK inventor has just devised an ingenious holder for a magnifying glass which will be of service to the dentist, the doctor, the jeweler, the bead worker the embroiderer and the stamp collector The magnifying glass is supported by a frame secured to a rubber band which slides on the wrist

Helping out the eyes

The Scientific American Digest

A Review of the Newest Developments in Science, Industry and Engineering

Conducted by Albert G. Ingalls

Motor Trucks That Run on Wooden Rails

A ROAD made of heavy poles on which trucks equipped with special wheels that will not run off are driven is the solution to the bad roads difficulty in a forest area in Oregon where large scale lumbering operations are carried on. These trucks can not lie down in the deepest mudhole in the world, like balky Missouri mules and defy their owners to move them for they run on tracks which resemble railroad tracks. They steer themselves.

Due to the heavy rainfall in Coos and Curry Counties in southwestern Oregon—which averages 72 inches annually motor trucks can be used in the extensive logging industry only about 100 days a year. Even during this period the 2½ ton auto trucks that are commonly used are too heavy in many instances. This means that the average load hauled is only 2000 board feet of logs.

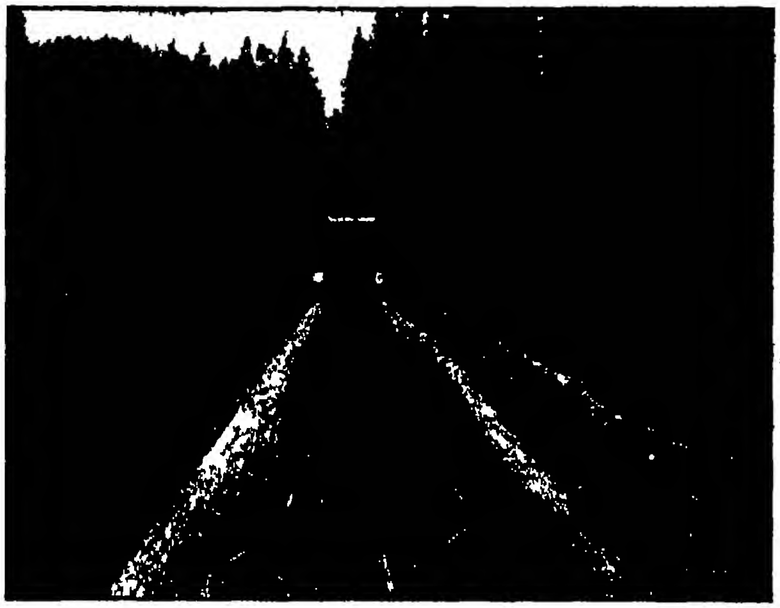
To overcome the adverse weather conditions a truck manufacturer has designed and manufactured for the Western White Cedar Company a 3½ ton tractive unit and a four wheeled trailer provided with 18 inch flanged wheels. This enables the lumber to be hauled on a road constructed entirely of logs.

This special truck is equipped with five forward and five reverse speeds. In high gear it will run at a speed of five miles an hour. As the flanged wheels fit perfectly to the poles the steering apparatus is disconnected thus allowing the driver ample opportunity to fix chains and see that his load is secure while the unit is in motion.

The unique road is formed of poles laid lengthwise like rails and supported underneath by heavy cross ties which prevent slipping and rolling. This roadway permits the lumber company to move their logs any distance from the woods to the river at a low cost.

When loaded the trucks can traverse grades as great as 4½ percent and when unloaded they can climb grades which average at times 7½ percent. Unusually heavy loads are hauled by this method 8711 board feet of lumber having been moved at one time. The average daily haul is 35000 feet. This was made in seven trips of a mile and three quarters each.

Ninety cents a lineal foot was the remarkably low cost of constructing this road—and 25 cents a thousand feet for the lumber hauled over it is figured as the cost of maintenance. It is estimated that 15,000,000 feet of logs may be hauled before it becomes necessary to replace the poles. Already over 4,000,000 feet have been transported from the forests to the river. The cost of hauling is $1.50, and the loading cost is 75 cents a thousand feet. When 8000 feet are hauled this represents a weight of 28 tons while the weight of the equipment is nearly seven tons.



Traversing an open space. The wooden track wears and splinters but more timbers are cheap and easy to obtain and lay in position

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Character Reading by Face All "Bunk," Say Scientists

TIME was when tall blond, blue-eyed men were considered to be the epitome of all the manly virtues of courage and initiative. To the small dark types, on the contrary were attributed the less positive qualities of timidity and reticence.

Modern science however now comes along and demolishes this theory. Psychologists have turned the battery of inquiry on the precepts and principles of professional character readers and pronounce the whole matter of character analysis based on physical traits as having no foundation on scientific fact. In other words it is all bunk.'

Prof G C Brandenburg of the Department of Psychology of Purdue University, Indiana has collected the results of these investigations of the self-styled character experts in a report shortly to be published in *Industrial Psychology*. Prominent in his account is a resume of a tryout of the so called color law evolved by a very well-known worker in this fertile field. The law states that blondes possess the dynamic traits that make the world's leaders pioneers and explorers, while the brunettes have the negative conservative and thoughtful qualities that make writers, research workers and investigators.

Over 90 disinterested persons were each asked to give character ratings of two blondes and two brunettes of his acquaintance. Examination of the details in the character ratings failed to show any constant differences between the two types, compared on the basis of the color of their hair.

Blondes were found to possess brunette traits to the same extent as the brunettes and vice versa" declared the investigators.

Prof H D Kitson of Columbia University and G L Donham of Indiana University undertook to check up the contention, stoutly upheld by many character readers, that weight and size are necessary assets in salesmanship. Some two hundred salesmen were examined and their respective sizes and weights compared with their selling records. On completion of the test it was found that the best salesmen were not, on the average, the tallest nor the heaviest, but were the men of medium size averaging around five feet nine inches with proportionate weight.

Even the significance of the profile, long a favorite character guide with almost everybody, is not allowed to go unassailed. No longer is the convex type with the prominent forehead and square jaw to be associated exclusively with the strong silent man of initiative and power nor the concave type with the more or less receding chin to be thought of only in connection with the patient, docile underling. Examination of a hundred students checking up the judgment of their intimates with their college records, shows that there was only a preponderance of 2 percent of the boys with the convex type of profile who displayed marked qualities of leadership.

In commenting on the researches of his colleagues, Professor Brandenburg declares that "in the light of critical studies on the question, we must conclude that as a method of character analysis the physiognomic system is wholly devoid of any scientific basis."
—*Science Service*

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New Synthetic German Petroleum

A NEW method of cheaper synthesis of a high grade motor fuel in Germany may go far toward the solution of the motor fuel problem in the future. The Berlin professor Franz Fischer, who recently devised means of making liquid fuels synthetically from coal products has now simplified his process so that he can dispense with costly high pressure apparatus that has stood in the way of its commercial development.

The new method produces a pleasant smelling gasoline as clear as water and one which will not harden or become gummy on exposure. The gasoline is highly volatile and is largely made up of unsaturated compounds like olefines which impart to the gasoline valuable anti knock properties. This enables it to be used in efficient high compression motors without objectionable knocking and with great economy.

A number of valuable by products may help to put the process on a sound commercial basis in the future. Certain substances of high boiling point condensing to heavier oils, may, by the use of catalyzing agents be changed to hard paraffine. The purified crystallized substance could be used in the manufacture of candles and other paraffine products, it is claimed.

Semi-coke a new industry by product for which a commercial use has not yet been found may be used as the basis of synthesis of this new gasoline. Semi-coke is left over in the low temperature carbonization of coal in the making of tar oils. In the Fischer process water gas from which the new liquid fuel is condensed can be made from coke or semi-coke, and the latter, it is claimed would be an ideal starting material.

Coke and coal are almost completely gasified when steam is led over them at a high temperature, and water gas a mixture of carbon monoxide and hydrogen, is formed. If this water gas could be transformed entirely into liquid motor fuel, the problem of the wasteless transformation of solid coal into liquid fuel, the dream of the modern chemists would be accomplished.

The Badische Analin und Soda Fabrik first succeeded in commercially synthesizing liquid fuels from this gas mixture in Germany by means of Dr Fischer's early method, in which pressures of 1,500 pounds per square inch or more were employed.

By his new process however, Professor Fischer has succeeded in synthesizing gaseous liquid and solid carbohydrates from carbon monoxide and hydrogen at ordinary pressure. Hitherto all reduction of carbon monoxide without pressure yielded methane, but Fischer found that by using an iron zinc oxide catalyzer, more complicated products were formed. Other metals and their compounds were studied and a cobalt chromium oxide mixture was found to stimulate the formation of gaseous liquid and solid carbohydrates when heated to about 518 degrees Fahrenheit.

The carbon of the carbon monoxide is said to be made into carbide by the metal, and the carbide then split by the hydrogen in the gas mixture. As a result the metal is regenerated and carbohydrates are formed.

In the old Fischer method a large proportion of the synthetic products formed were highly oxidized, but in the new normal pressure process they are unoxidized. Professor Fischer found that if the temperature was raised, the formation of higher carbohydrates stopped and methane was again formed.—*Science Service*

Hauling a heavy load through the forests of southwestern Oregon. The load on the trailer is nearly as great as that on the truck

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Liquid Oxygen Explosive

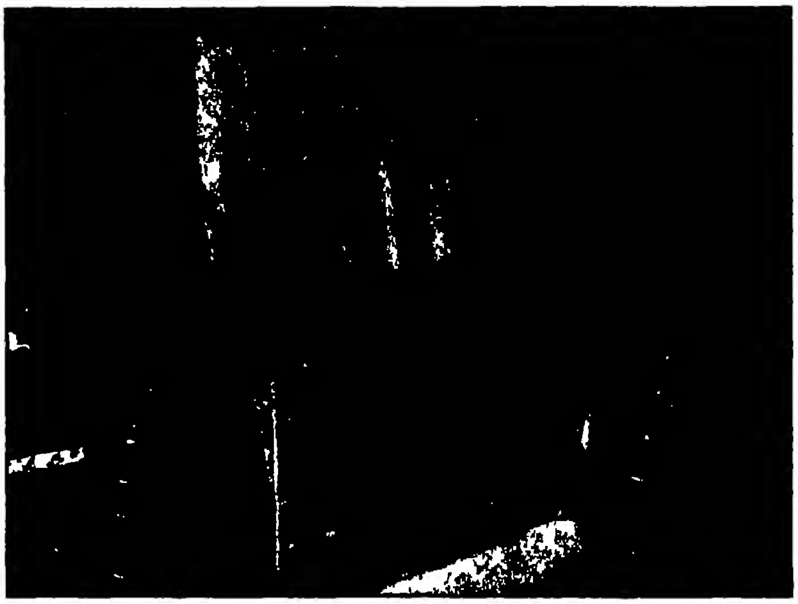
INTENTLY at work in his laboratory some fifty years ago, a French scientist, Louis-Paul Cailletet, inadvertently opened the wrong valve in a whirring apparatus before him—and made history by doing it.

(Continued on page 448)

Nothing exploded, there was not even a sputtering spark but what happened gave Cailletet the thrill of his life and the scientific world a portentous discovery

In an ordinary glass tube upon which the Frenchman had fixed an expectant gaze during years of experiment he espied a drop of moisture It lingered but a moment little more than a vanishing mist But this one vagrant drop, produced through a fortuitous mistake signalized the harnessing of an invaluable force

Liquid oxygen blast at the moment of explosion in a limestone quarry at Myerstown, Pennsylvania. The bench in the foreground, which is torn asunder by the blast, was 30 feet high and 60 feet wide. The cartridges were set 28 feet below the surface of the bench



The box in which the cartridges are first soaked in oxygen so that they may absorb the liquid. Liquid oxygen transportation containers are seen standing around the cartridge box. Each of these large cans has a capacity of 15 liters, approximately 15.8 quarts

The enthralled Cailletet, when he touched the wrong valve and observed the fleeting drop of moisture knew only that he had discovered a way to reduce gases from the air to a liquid form and bottle them up It remained for scientists years later to find out how to utilize this concentrated power Although the every day world up to this time has heard little of liquid oxygen this substance has within the last decade taken its place as one of the notable discoveries of modern industry

Liquid oxygen is literally air reduced to liquid form, from which in process of powerful compression nitrogen is distilled off In the alternating process of compression and expansion through which it is produced it reaches a temperature of 269.5 degrees below zero Fahrenheit

In its quiescent form when not in use as an explosive liquid oxygen instantly freezes all substances immersed in it Poured on ice it vigorously boils so much warmer is the ice than it Flowers dipped in it will become frozen to the rigidity of porcelain An appetizing tender steak will become so tough and solid under its effect that it may be used as a hammer

Liquid oxygen explosive or L O X as it has come to be known is made by mixing very finely divided carbon which is in the form of lampblack or carbonblack with the liquid oxygen which is of course highly concentrated oxygen The association of the carbon and the oxygen is so intimate that when combustion is started due to a fuse or detonator the carbon instantaneously burns and creates a large volume of highly heated carbon dioxide gas

At the moment of combustion or explosion the temperature of liquid oxygen jumps from 269.5 degrees below zero to 5603 degrees above Fahrenheit a range of 5872.5 degrees The shattering force of this combustion is sufficient to rend asunder huge strata of rock

The practicability of liquid oxygen as an explosive has been put to test by the United States Bureau of Mines It has been found particularly advantageous for blasting rock in quarries or in other open rock formations During the war when the Germans ran short of glycerine and Chilean nitrates they found it imperative to evolve a substitute for dynamite as an explosive Their engineers, who had been working for years on the process of liquefying oxygen, put it into use as an explosive in underground mines

In the last few years liquid oxygen has been used in quarrying in New York, Pennsylvania Colorado and other states, with significant results as compared to the use of dynamite

In one conspicuous experiment which was recently made by the Air Reduction Company and the Ingersoll Rand Company sixty cartridges of liquid oxygen were placed in twelve holes 28 feet deep and six inches in diameter A single trunk fuse was used to set off all the cartridges simultaneously The drill holes were set 12 feet apart in a 30 foot rock bench

The cartridges fitting snugly were 18 inches long and 5½ inches in diameter five being placed in each hole They were encased in bags made of stout muslin and filled with finely divided carbonaceous material of a highly absorbent nature

Out of 1014 pounds of liquid oxygen into which the cartridges were dipped each one absorbed 15 pounds or 940 pounds for all Since the cartridges were immersed in relays one hour and a half elapsed from the time they were dipped until they were placed in the drill holes This fact is pointed out by engineers as emphasizing that even with a relatively rapid evaporation of liquid oxygen sufficient time may be taken for deliberate placing of the cartridges so as to obtain the most effective results

The safety of blasting with L O X is one of its characteristics recognized officially by the Bureau of Mines Its cartridges cannot be set off except by a very severe shock such as the impact of a bullet The Bureau of Mines says of it "No danger exists in the transportation of this explosive to the point of use. Practically no danger exists of premature explosion Danger of misfire in event a cartridge is not properly exploded is eliminated by waiting a sufficient time to allow for the evaporation of the oxygen (The time necessary depends on the diameter of the cartridge)

"An unexploded stick of dynamite is always a menace if encountered while mucking or during the removal of coal or ore from a mine but the liquid oxygen cartridge, under similar conditions is dead."

In Europe there are many plants producing liquid oxygen One mining company in Lorraine is mining its entire output of iron ore by liquid oxygen explosive and it is estimated that fully 80 percent of the iron ore mined in France is being blasted with L O X New liquid oxygen plants are now being built in this country

* * *

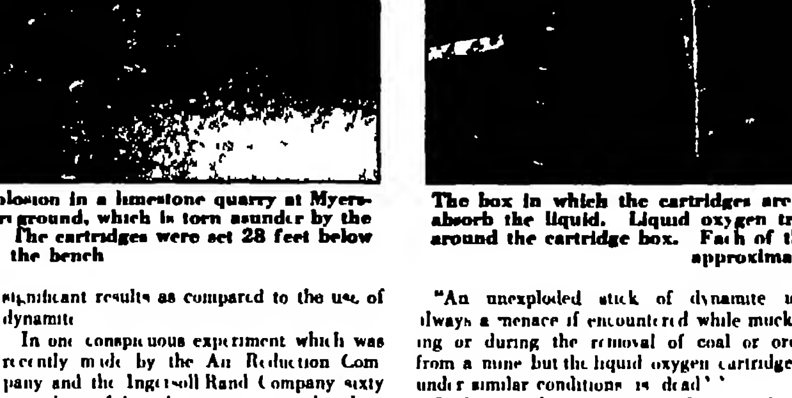
Forerunner of the Caterpillar Tractor

Probably in no part of the world were the limitations of the old steam tractors more keenly felt than in the soft reclaimed peat lands of the San Joaquin and Sacramento River deltas of California These lands were very soft—so yielding, in fact, that it was necessary to provide broad wooden shoes for the horses

The early day manufacturers attempted to meet these conditions by constructing tractor wheels of great width About 1898, Benjamin Holt of Stockton, California built a tractor (shown in the accompanying illustration) for Charles Moreing a delta land owner This machine had wheels eight feet in diameter and 18 feet in width

The difficulty with this enormous engine was that the weight increased in proportion to the width of the wheels. Therefore, little advantage was gained

About this time Benjamin Holt realized that an entirely different principle must be worked out He built a pair of tracks or "platform wheels," as he then called them, and tried them on one of the old steam tractors. The materials for this first crawler tread came from the scrap pile about his shop, but the result was so satisfactory that he was encouraged to continue his experiments The next attempt was still more successful—and thus the modern "caterpillar" tread came into being



The old steam tractor, built in 1898, whose bulk and unwieldiness induced Benjamin Holt to invent the crawler tread

* * *

Effect of Milk on Weight and Height

Milk for growing boys and girls is a universal slogan, but actual experiments to prove its value have produced figures that astound even the medical authorities

Dr H C C Mann has just reported to the British Medical Research Council the results of one of the most extensive nutritional experiments ever undertaken It lasted four years and involved over 500 boys This investigation has demonstrated that the addition of a pint of milk a day to a diet that satisfied even a growing boy's appetite brought up the yearly average gain in weight from 3.85 pounds to 6.98 pounds and increased the gain in height from 1.84 to 2.63 inches

The boys used as subjects for the experiment mostly foundlings who had previously been examined to exclude the possibility of disease, were housed in cottages in a suburb outside of the city Living conditions and discipline were excellent according to Dr Mann, while short vacations and absences assured almost continuous observation throughout the whole period

The boys were divided into different groups one of which received only the basal diet that was planned to meet the demands of the child of school age This dormitory fare was judged by physicians to be equal and even slightly better than that customary in working class homes, while periodic physical examination of the boys in this group showed them to be in good physical condition

To find out what classes of food would produce the most increase in height and weight, other groups were each given extra rations of sugar, fresh butter with a high vitamin content, fresh cow's milk, vitamin deficient margarine and concentrated protein equal in food value to the meat in the regular diet

The milk and butter groups were found to make the largest gains, the boys who had the pint of milk being far in the lead with

(Continued on page 450)

an average gain of nearly seven pounds a year and over two and a half inches in height Casual visitors easily picked them out as being obviously more fit than the others" The whole group enjoyed exemption from illness Dr Mann stated when sickness in the other houses was more prevalent than usual -- *Science Service*

* * *

Tornadoes Started by Oil Fire

TORNADOES smaller than the twisters that often work havoc in the Middle West but true tornadoes just the same were one of the effects of a great oil fire at San Luis Obispo California recently, according to a report to the United States Weather Bureau by J F Hissong of the local weather bureau of the California city

The fire was started by lightning and burned for five days, destroying nearly six million barrels of oil Two persons were killed and the total property loss was estimated at 15 000 000 dollars. However, the unique feature of the fire was the great number of tornadoes which it started one of which was responsible for the two deaths.

Before these whirls started says Mr Hissong, strong southerly winds prevailed, which shifted to west and then to north west. Then four tanks, each containing 750,000 barrels of oil "boiled over"

"They threw out an immense quantity of hot burning oil" he says, 'which spread with remarkable rapidity over an area estimated by the engineers present at about 900 acres. The flames seemingly leaped a thousand feet into the air At the same time violent whirlwinds began to form over the fire

"From the time the wind veered into the northwest and the large reservoir boiled over, hundreds of whirlwinds formed in and around the edges of the fire until the last tank boiled over During the period when the large reservoirs were burning and the temperature over the fire was probably at its highest point, and consequently the vertical convection was strongest, the whirls appear to have been most numerous and violent

"Many of them had all the characteristics of true tornadoes. The gyrating, writhing funnel-shaped clouds with the white condensing vapor in the vortices were plainly visible against the background of black smoke Some of the funnels appeared to be not more than one foot in diameter at the smallest part and some were reported as giving the impression of ropes dangling from the clouds of smoke"

It was one of these twisters that caused the casualties for it left the fire, traveling east northeast to a cottage about a thousand yards away It picked up the cottage, lifting it several feet in the air and carried it about 150 foot north There the cottage was dropped in a field, a total wreck, and the owner and his son who had been in it at the time, were killed A few minutes later a whirl, which Mr Hissong believes might have been the same one unroofed a house about a quarter of a mile northeast of its first victim Debris, evidently carried by other whirlwinds, was found as far as three miles from the fire

Since the whirlwinds started just after the wind veered Mr Hissong suggests that they may have been caused by the convectional currents over the fire being started rotating by the northwest wind *Science Service*

Mr. Grant's telescope is mounted on a fork made of brass pipe-fittings

* * *

Maine Quarryman Makes Telescope

IT is always a source of keen interest to the telescope editor to observe the many ingenious ways by which the amateur telescope makers work out the essential parts of their mountings Mr James Grant the owner of a quarry at Hall Quarry Maine, sends us the following description of his telescope, made from the instructions published in 'Amateur Telescope Making"

'I ground and polished the mirror my self, following the instructions given in your book, 'Amateur Telescope Making' I am therefore obliged to you for enabling me to build this six inch, four foot telescope and for giving me an opportunity to indulge in the most interesting and instructive field of amateur work an individual can take up

'Like many others for years I had a desire to possess a telescope, and when Mr Porter's articles appeared in the Scientific American I immediately began assembling equipment for the grinding and polishing of a six inch mirror In the cellar of our house I placed two weighted barrels, one in one part of the cellar for grinding, and the other in an enclosure having a solid floor and bench This room was used for polishing and testing by the Foucault knife-edge test

"You would not have space for the details of my adventures in grinding and in making and using the pitch lap for polishing the mirror Sometimes amusing often rather discouraging tribulations and trials were my lot, all of which were, however, overcome with gratifying results. To me the delightful interest derived from testing alone repaid me for all the work in grinding and polishing.

"Having tested, and finding results as shown by illustrations in the book, I was delighted But fearing nevertheless that I might not have the mirror just right I sent it up to Mr John M Pierce of Springfield, Vermont, who kindly looked it over and returned it to me, pronouncing it a 'peach'

"I built a simple mounting along the lines described by Mr Pierce and Mr Porter in the book. The foundation of the mounting is of concrete, the upper story in the shape of a New England church the steeple inverted to make the polar axis. A one inch iron pipe was imbedded in the concrete In this a 3/4 inch brass pipe about 18 inches long revolves The mount I chose was the English type, the fork being made of 3/4 inch brass pipe The center of the fork is a pipe tee Two nipples, two elbows and two short pieces of pipe complete it On the end of each side of the fork there is a tee into which a 1/2-inch iron pin from the 1 1/2 inch x 1/4 inch flat iron band on which the 4 foot galvanized iron tube is hung, is inserted

"The overhang is regulated and controlled by a mechanical contrivance made from the pinion wheels of a discarded electric blasting battery which we used in the granite quarries I would have liked to show this device more plainly in the picture as I find it easy by this means to control the telescope in finding any object in the heavens. It also enables the telescope to be held rigid when the object is found, and gives excellent results."

Courtesy of the United States Weather Bureau

Formation of a tornado cloud over an oil fire at San Luis Obispo, California. This phenomenon took place on April 7, 1926

Courtesy of the United States Weather Bureau

This photograph was taken subsequently to the one at the left. It discloses the further development of the tornado cloud

* * *

"Radio-Operated Furnace"—A Correction

IN our description of the radio-operated furnace, August issue, page 135, we inadvertently stated that "licenses were issued by the Government . . . . permitting manufacture." As a matter of fact the licensing of this apparatus is controlled by the Ajax Electrothermic Corporation.

* * *

A Graphic Sketch of Arctic Perils

A FACT not known to the average person is that Oxford University has sent three exploring parties into the arctic regions. Therefore, "With Seaplane and Sledge in the Arctic" (George H Doran Company, New York) should prove of value to those who are interested in that great area at 'the top of the world."

This new book, contrary to the usual records of exploration, is a most interesting volume. It gives a brief résume of the 1921 and the 1923 expeditions and deals in complete detail with the one that went forth in 1924. The story of the trials and tribulations of the party are couched in such language that the reading of it becomes a treat rather than an educational duty

The 1924 expedition was concerned chiefly with the exploration of North-East Land and so the records deal with the findings there. At the same time, the author George Binney, leader of the party, manages to include many personal touches, some of them gleaned from the diaries of the various members of the expedition

The appendices are also an interesting part of the work and their inclusion was certainly a happy thought In them, one will find much interesting datum. For instance, if the reader wants to spend a few months in arctic exploration, the information in the appendices will prove invaluable Costs of equipment, the arrangement of the press and film rights, members' contracts and other important details are dealt with All in all, this record of exploration is a notable work.

Glass That Will Not Splinter

THE production of safety glass of various types has been attempted before in the United States Its drawbacks to date have been either that it had reinforcing wires that do not favor clear vision, or that it took on a yellow tinge with time, which had an obscuring effect.

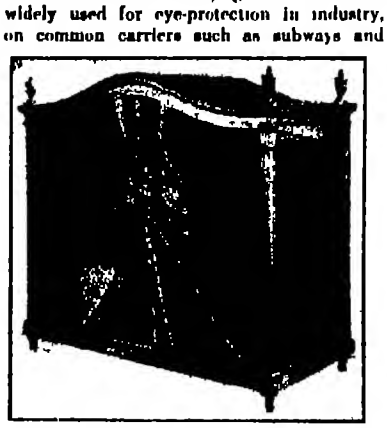
Triplex safety glass is new only in the United States. It has been made and widely used in England since 1914. It has absolutely clear vision, with no discoloration.

(*Continued on page 452*)

Actually, it is two sheets of the finest plate glass, with a middle layer of pyralin. The three layers are pressed together under heat, and at a pressure of 1,500 pounds per square inch. Due to this enormous pressure, the plate glass will crack and be destroyed in manufacture if it has the slightest irregularity on the surface. Hence the makers go to Czecho-Slovakia for the best plate glass obtainable. Preparations are now under way, however, to make such glass in the United States.

Passenger car equipped with triplex safety glass, after a collision with a truck. Passengers in the car were uninjured, receiving only bruises

Under a very heavy blow, this glass gives way but does not shatter or splinter. Consequently it cannot cut anyone. Three-quarters of the injuries in auto accidents come from flying glass, and jewelry store thieves thrive on common plate-glass windows. In these two fields lie the most obvious uses for this safety glass. It is also widely used for eye-protection in industry, on common carriers such as subways and busses in England, on airplanes et cetera. It can not be cut with a diamond. It was triplex which Mussolini ordered for his cars after the recent bomb attack.



Diamond display case, hit with a heavy hammer by a man standing six feet away. A hole is broken through the glass, but a flap of glass still hangs over it. If a man could insert his hand, he could not remove it, due to the flap

* * *

What Does an Engineer Do?

"LAST spring," said President A. E. Morgan of Antioch College recently "one of our freshman students was failing in his work and we asked him in for a talk. This is the substance of what he told us:

"'I have lost interest in my studies because they do not prepare me for my life work. I want to be an engineer and here I am, near the end of my freshman year in college, and I know no more of engineering than when I came.

'I have been kept at chemistry and mathematics and English and physical education, and such things, when I want engineering. Out on my cooperative job,' [the students spend half time at college classes, and half time in practical work, changing every five weeks] 'I am simply a workman in a construction crew. I suppose an engineer planned the work, but I had nothing to do with that part.'

"This boy expressed what a million other boys and girls feel. They want to get at their life work, and they do not want any unnecessary matters to interfere. In twenty-five years of work as an engineer, I have come to know something of what an engineer is called upon to do. We all know that an engineer needs mathematics and physics and mechanical drawing and other subjects as closely associated with his work and I will not discuss them. I will talk about matters that do not seem as closely related to engineering.

"An engineer should be a master of English. If he uses words carelessly and inaccurately, he and the people he works for will be forever in trouble. Every large engineering job is built 'according to specifications.' These specifications are detailed exact descriptions of the work to be done and of the material used. Every year there are hundreds of lawsuits in the United States involving many millions of dollars, in which the point at issue is the question what do the specifications really mean?'

"No one can write clearly without long and careful practice. There has been a prejudice against English among engineering students, and as a result many of their specifications are badly written. Possibly a shrewd contractor and his lawyer will read these over word by word and sentence by sentence and will find some loophole by which they can escape doing the work as intended or can collect more money for it than was intended.

"A journalist may get along with careless writing but an engineer cannot. Very few men have their words read so carefully and so critically. A slip in using the word 'and' instead of 'or' may cost the engineers' clients thousands of dollars.

"It is not only in writing specifications that the engineer needs to express himself well. Very many projects are accepted or rejected on the report of the engineer. Only if he can express himself clearly accurately and briefly can those he works for understand what his reports are about. Moreover, most great engineering works vitally affect everyone. Unless the engineer can tell the public in clear, plain language what his purposes are and how he plans to accomplish them, he has trouble ahead.

"Now let us touch on another field, seemingly remote from engineering—the appreciation of beauty. In a primitive community, people may be satisfied to have ugly structures around them if they only are strong enough. But as soon as the public develops taste and self respect it begins to demand that its useful things shall be beautiful as well. The engineer is forever changing the face of the earth, and if he has a sense of beauty he adds very much to his value. The more intelligent the people he works for, the more they will demand this quality in his work.

"Strange as it may seem, an engineer needs a knowledge of history and economics. Some years ago I directed a great engineering project where a knowledge of history affected the cost of the job to the extent of several million dollars. We were designing works to last for centuries, and the lives of thousands and perhaps hundreds of thousands of people depended upon their being always in working order. If we could depend upon a continuance of reasonably honest, intelligent government we could plan cheaper works which, however, would require perpetual careful supervision. If we should build such cheaper works, and if then the government should fall into incompetent hands, a catastrophe might result. What did history teach as to the probabilities? It taught us that we should spend the extra millions and make the works safe even with ignorant and inefficient management.

"An engineer should have a knowledge of economics. 'Will this project pay?' That is a question most often asked him. Unless the engineer understands some of the principles governing production and exchange, unless he can estimate in a general way the economic effects of his work he will be an unreliable guide. Many great projects have been built in this country on the advice of engineers, only to develop into failures or too costly successes because the engineer was ignorant of economics.

"The engineer needs to understand social and industrial relations. Some years ago I was asked by some men having money to invest to recommend to them a great reclamation project in the south. I refused, saying I thought the project would not be feasible for many years. The soil was extremely fertile, the engineering conditions were favorable, and the project could, no doubt, be constructed. But I believed that the people who were counted on to settle on the reclaimed land would not accept the social and climatic conditions. The project was built, seemed at first a success, but ended in disastrous failure, because the settlers all left.

"I have spoken of engineering, because that is my field, but the same principles apply in law, medicine, architecture, business, and in most callings. There is an old saying about the intelligent, well informed man that 'all is grist that comes to his mill.' Such a man makes the most out of life.

"At Antioch College, at Yellow Springs, Ohio, we have organized college education with these facts in view. We believe that the best preparation for any calling is all-round education and all round experience, supplemented by special training for that calling. Antioch students are preparing for business, engineering, finance, journalism, scientific research, home economics, education, and other callings. But nearly half their time at college classes is spent in getting a sound, general education in natural science, social science, English and literature and other subjects of universal value."

* * *

On Again and Off Again Without an Arc

A PHOTOGRAPH of the first invention to be worked out and perfected in the million-volt laboratory of the California Institute of Technology at Pasadena, California, is reproduced in these columns. It is a vacuum switch, the product of the work of Prof. Royal W. Sorenson, aided in his experiments by Dr. Robert A. Millikan.

The invention is designed to take the place of costly and ponderous oil immersion switches that have been used in large power plants to cut off heavy currents of electricity on short notice. The principle upon which it is based is the well-attested fact that electricity will not travel through a perfect vacuum. A terrific arc results when a high-tension current—say of 100,000 horsepower—is cut off in the open air. Some protective device is necessary. Heretofore, extremely large, expensive oil immersion switches have been installed in all large power plants to quench these arcs in times of emergency. In the splendidly equipped laboratory of the Institute, Prof. Sorenson has been able to establish a virtual vacuum within a small glass bulb which, placed as shown, serves as a cut-off switch.

Wide World Photo

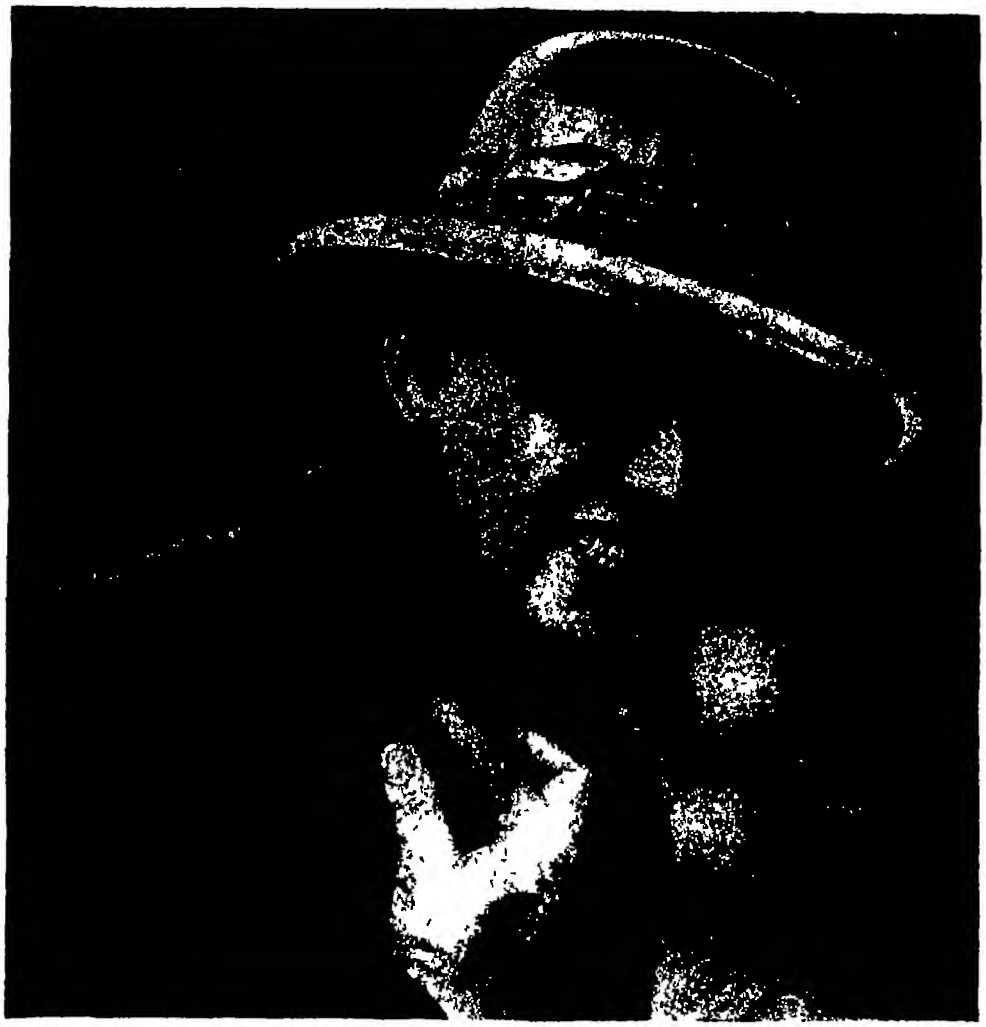
Prof. Royal W. Sorenson, inventor of the vacuum switch

Professor Sorenson's new vacuum switch, containing only one billionth part of the original content of air. The near-vacuum prevents arcing

"We have fully established the theory, and all our tests have been successful," he explains. "We have handled a circuit up

(Continued on page 454)

WATCH YOUR THROAT!



Don't let it become serious!

AS you probably know, certain harmful bacteria are constantly present in the mouth and throat. And unless proper precautions are employed these disease germs may often get the upper hand and multiply more rapidly than nature can fight them off.

At such times your throat becomes irritated —Nature's way of telling you there is danger ahead.

Particularly at this time of year everyone should watch the throat very carefully The ideal mouth and throat protection is the systematic use of Listerine, the safe antiseptic.

Its regular use by the entire family, as a mouth wash and gargle, is an easy way to be on the safe side

Also, then you will be on the polite side in regard to that insidious condition, halitosis (unpleasant breath). — Lambert Pharmacal Company, St Louis, U. S A

Risk a quarter!

Risk a quarter on our reputation Buy a tube of Listerine Tooth Paste. Our reputation won't suffer

LARGE TUBE—25 CENTS

LISTERINE

—the safe antiseptic

to 1000 amperes at 40 000 volts safely and without any difficulty whatsoever Probably we could have used more had the power been obtainable The next step will be to make the simple device commercially practicable.

When the new method was tried out recently in a California station the vacuum switch-gap was left open only one inch However the entire current of 40 000 volts stopped instantly without so much as registering on the oscillograph record which is tuned" to the thousandth part of a second in order to catch such disturbances

It was Prof Sorenson who conceived the idea of what he calls a cascade hook up by which four of the hitherto largest transformers—each with a capacity of 250 000 volts—could be linked into one giving the marvellous output of a million volts for the use of scientific research. Several such super plants, using his hook up have been built in the east in the past few years

A specially designed building was prepared at the Institute to house the four units now in use Each may be operated independently or in a number of combinations that are tremendously interesting to experts. The transformers are of the core type the cores being two-legged with half the winding on each leg. They are of course of the indoor type approximately ten feet in diameter by sixteen feet high over the lead top The weight of each when filled with oil is 45 000 pounds

Intricate elaborate and as complete as human ingenuity has yet devised is all the equipment with which these eager scientists are working seeking to evolve new things to benefit mankind The vacuum switch merely happens to be first

* * *

A Simple Spectroscope

A GREAT many of the scientific instruments which are used by the modern astronomer are designed to help him in the study of the light emitted by stars and among these instruments the spectroscope is one of extraordinary importance With the aid of the spectroscope he has been able to determine the stage of development of certain stars He has also been able to measure their speed and ascertain the direction of their travel through the boundless spaces of the universe More than that he has been able by using the spectroscope in conjunction with the sensitive photographic plate to print the spectra of stars and thus to establish permanent records of great value to himself and to the astronomers of coming generations

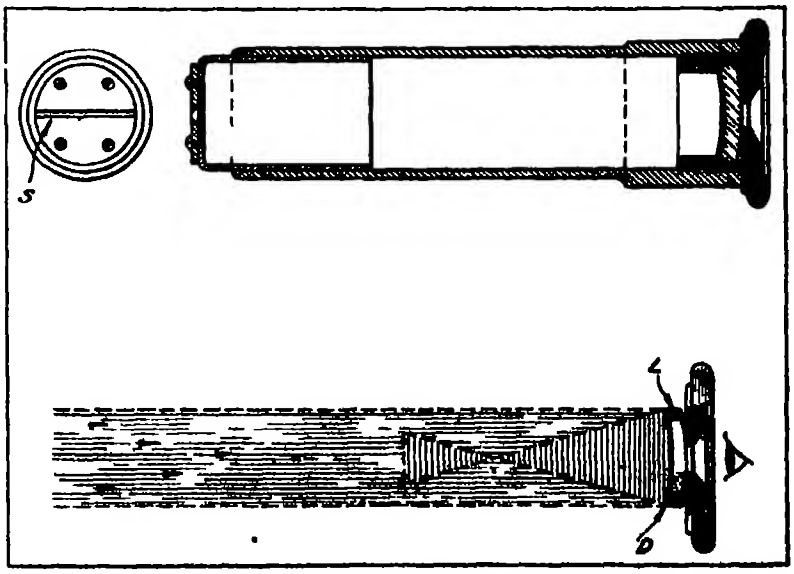
In the broadest sense the spectroscope is used to analyze light White light as it comes from the sun for example is composed of light of all colors each having its characteristic wavelength violet has the shortest and red the longest waves. The different colors are separated by the spectroscope which shows them in a continuous band from violet to red This band of colors is called the spectrum The rainbow, for example represents such a phenomenon, In it the drops of rain bring about a separation of the sun's light The finer and more accurate the mechanism of a spectroscope the more details will be revealed in the spectrum and the finer and more distinct will be the different nuances in each color

The type of spectroscope the astronomer uses in his exacting scientific investigations is an instrument of great sensitiveness intricate in its mechanism and requiring the trained mind and the skilled hand of an expert to operate it For the amateur who

A refracting telescope equipped with a small spectroscope The right angle prism at the elbow in the tube was added for comfort in observing

likes to study spectroscopic phenomena this kind of instrument is as a rule too cumbersome to manipulate and too expensive to acquire The little instrument pictured here however is a simplified type of spectroscope It is easy to handle and can be made by anyone having ordinary skill in things mechanical Its description was submitted by Ernst Keil of the Department of Zoology at Denison University

The elements of this simple instrument are all contained in one tube about four inches long and one and one quarter inches in diameter It consists of three parts, a tube which carries at one end a narrow slit and at the other end the eyepiece This eyepiece is the most interesting as well as the most important part of the whole instrument It contains the lens and a transmis



***Above:* Longitudinal and cross sections of a home-made spectroscope. *S* is the slit *Lower:* The optics of the spectroscope shown above. *L* is the lens. *D* is the diffraction grating applied to its curved face. The plane on which the spectrum is formed is indicated by the vertical arrows**

sion grating The lens is an ordinary plano concave spectacle glass given a circular form, with a focal length of about three inches. With a little care it can easily be trimmed to the desired form on a grind stone or fine emery wheel The transmission grating is a piece of transparent replica made from a diffraction grating it is placed on the concave side of the spectacle glass pointing toward the slit The replica grating, which may be purchased from manufacturers of scientific apparatus for a few dollars is prepared in the following manner the replica proper that is the thin celluloid film which contains the grooves is as a rule mounted on a piece of plate glass This film is carefully peeled off the glass and a piece the size of the lens is cut out and placed on the concave side of the lens

The light enters through the narrow slit striking the grating at the other end of the tube thus producing a spectrum inside the tube This spectrum may readily be observed through the opening in the eyepiece

This instrument lays no claim to the accuracy of its more intricate brethren nor will it cover so wide a range of work nevertheless it may very successfully be employed for spectral analysis in its simplest form If care is taken to select a replica with a powerful first order a comparatively large and brilliant spectrum will be obtained with many of the brighter spectral lines distinctly visible

There are several ways in which this spectroscope may be used One may hold it in the hand and view directly the source of light to be analyzed or it may be placed in the ocular end of an astronomical telescope

In the latter case the performance is as follows: the telescope is focused sharply on a star then the eyepiece is carefully withdrawn and in its place the spectroscope is inserted In the case of some of the brightest stars and under favorable atmospheric conditions very interesting results may be observed

We belive Dr Anderson of the Mt Wilson Solar Observatory Pasadena California was the first to suggest this type of spectroscope

[A small home-made spectroscope suitable for use with 3¼ x 4¼ camera plates was described in the March 1926 issue of *Popular Astronomy* (Northfield Minnesota) —Editor]

• • •

Temporary Mounting for Telescope Mirror

Elegant details and fine machine work may or may not improve the optical efficiency of a reflecting telescope Mr Stanley Bentley of 973 Terrace Fifty Los Angeles California has demonstrated that a useful instrument may be made of simple parts provided the optical elements are first class Mr Bentley sends us the following description of his telescope a photograph of which is reproduced in these columns

"The mirror is eight inches in diameter

Mr. Bentley and his wooden telescope mounting

one inch thick and the tool was half inch glass. The focal length is 80 inches. Not having an oil lamp for testing I used a frosted Mazda electric lamp in a tin can having a needle hole in one side.

"I started the figuring of my mirror with a deep depression in the center and three zones surrounding it. These later worked out into a hyperboloid, but this succumbed at last, thanks to the excellent instructions in your book. I now have a mirror which, I think, deserves a real mounting and I intend to make this soon. The total cost of the instrument was $12.50."

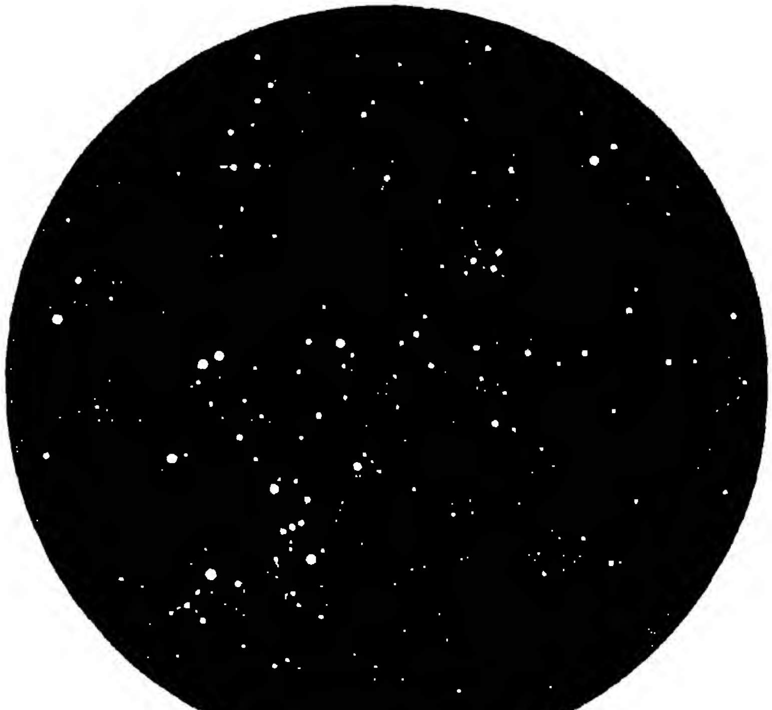
Mr Bentley writes that before attempting to make an eight-inch mirror he made a simple four inch mirror of 5/16th inch plate glass. This, with a simple mounting, cost $5.92. The experience gained on this preliminary job proved invaluable on the large mirror

New Method of Case-Hardening Alloy Steels

A NEW method of producing a very hard steel skin on chromium, aluminum and manganese steels has been worked out by scientists of the Krupp works at Essen, Germany. The metal to be so treated is provided with an atmosphere of nascent nitrogen at a temperature under 1,100 degrees, Fahrenheit. Allowed to cool slowly, the steel actually absorbs some of the nitrogen, which results in a measurable increase in volume of the steel. It is claimed that the process, which can be employed with the ordinary quenching methods, produces steel which is especially suitable for machine parts working at high temperature where even superior alloy steels frequently prove to be inadequate for the work at hand.—*Science Service*

The Heavens in December

By Professor Henry Norris Russell, Ph.D.



At 11 o'clock Dec 7
At 10½ o'clock: Dec 15
At 10 o'clock Dec 23

At 9 o'clock: Jan 7
At 8½ o'clock: Jan. 14.
At 8 o'clock: Jan 22

At 9½ o'clock December 30

NIGHT SKY: DECEMBER AND JANUARY

The Heavens

ON our star map this month Castor is conspicuous high in the east along with its neighbor Pollux Far above, and even brighter, is Capella while Procyon is to the right and a little below Sirius is well up in the southeast Betelgeuze and Rigil, with the other stars of Orion, are above, and higher is Aldebaran Mars, a little to the westward, outshines them all but Sirius The southwestern sky is very dull but Pegasus and Andromeda enliven the west, and Perseus is above in the zenith Cassiopeia is high in the northeast, and Cygnus is setting below Ursa Minor and Draco are low in the north, and Ursa Major in the northeast Leo and Hydra, just rising complete our list of constellations

The Planets

Mercury is a morning star this month and best visible about the 14th, when he is apparently farthest from the sun and rises at 5 30 A M Venus is just coming out as a morning star, but as she sets only half an hour after the sun she can be seen only with great difficulty Mars, although well past opposition, still dominates the evening sky He is in the western part of the skies and is due south at 8.30 P.M. in the middle of the month, remaining in sight until after three in the morning. By the end of the year he is almost twice as far off as he was in October, but he is still a brilliant object, and well repays telescopic observation

Jupiter is an evening star in Capricornus, setting at about 10 P.M on the 1st and 8:30 on the 31st. Saturn is a morning star, rising about 5 30 A M On the 15th he is in conjunction with Mercury The two planets are but one-third of a degree apart, and should be conspicuous just before dawn. Uranus is in Pisces, and comes into quadrature east of the sun, on the 18th, so that he is observable in the evening. Neptune is in Leo, and can be seen (telescopically) in the early morning.

The moon is new at 1 A.M on the 5th, in her first quarter at 2 A.M on the 12th, full at 1 A M on the 19th, and in her last quarter at midnight on the 26th as this day closes. She is nearest the earth on the 12th, and farthest off on the 26th.

During the month she is in conjunction with Mercury on the 3rd, Saturn on the 4th, Venus on the 5th, Jupiter on the 10th, Uranus on the 12th, Mars on the 15th, Neptune on the 23rd and Saturn again on the 31st

At 10 A.M on the 22nd the sun reaches its greatest southern declination and "winter commences."

Radio Notes

A Review and Commentary on the Progress in This Branch of Rapid Communication

Conducted by Orrin E. Dunlap, Jr.

Wide World

Captain R. H. Ranger (left) and his improved radio-picture apparatus designed for sending illustrations between New York and London

Sees Big Future for Radio Business

RESEARCH work in radio will naturally go on indefinitely according to George A Scoville Chairman of the Merchandising Committee of the American Manufacturers of Electrical Supplies

"Refinements such as we find making their appearance in the automobile field will no doubt follow in radio But it is safe to say that a few of the better receivers now on the market can be looked upon by the purchaser as coming fairly close to a permanent investment" said Mr Scoville

It is the opinion of radio officials that out of the approximately 4 000 000 sets in use in the United States at least half of them are so far behind modern developments that there will be evident a great desire on the part of the public to replace the old sets with new This means a future potential market of those already acquainted with radio of about 2 000 000 receivers In addition there will be at least an equal number of people out of the 12 000,000 who own phonographs who will purchase radio sets this year From an estimated volume of 500 000 000 dollars in 1926 it is believed that it is conservative to state that 1927 will show the industry has reached a figure exceeding 650 000 000 dollars

German Radio

RADIO broadcasting in the United States is two years ahead of European development, according to Gunter Doherzinsky a director of the Central Germany Broadcasting station at Leipzig, who recently visited in this country

"I have examined many radio receivers and visited factories and broadcasting stations and am amazed at the progress you have made," said Mr Doberzinsky "Unquestionably Europe has much to learn from America in radio The American sets tend toward greater simplicity and are controlled by a single dial Your sets can be tuned by a finger, while in Germany we must tune with both hands And in Germany one must pay equivalent to 250 dollars for a good set

"It is possible to receive in Germany with one tube, or even a crystal set, with fairly good results The stations are nearby and there is little interference A crystal set can be bought for $1 50 and a one tube set for six dollars which will enable you to listen in on a single station Those who wish to hear distant stations must have good sets but the demand has been limited That is why high grade sets have not developed as rapidly in Europe as in the United States Europe still uses the old fashioned horn for a loudspeaker The modern cone loudspeaker is practically unknown

American and German stations are financed very differently said Mr Doberzinsky Our stations have plenty of money at the present time but lack the element of competition you have in the United States In Germany 51 percent of the stock of the broadcasting stations is owned by the government and 49 percent by private stockholders Every owner of a receiving set pays 50 cents a month for the privilege of listening in Since there are more than 1 000 000 receiving sets in Germany today the income is obviously large Of the total sum thus collected 40 percent is devoted to technical work and building of stations and 60 percent is devoted to operating expenses There is but one broadcasting station in each of the large German cities so each is well supplied with money and in many cases the stations support fine orchestras and large opera companies However we lack the competition that is present in the United States and competition is necessary to develop new ideas and a high grade of entertainment in general

One of the newest radio developments in Germany is the railroad radiophone It is possible to pick up a telephone on a train and be connected with any telephone in any part of Germany by radio The traveler enters a telephone booth in the dining car and asks for a number exactly as he would make a local call in New York The connection is established very quickly and one can talk under these conditions with perfect satisfaction A train passenger can telephone across Germany for about a dollar"

Navy Installs 80-Kilowatt Station

A RADIO transmitter rated with an output of 80,000 watts, said to be the largest vacu-

Kadel & Herbert

This six wire cage is used as a lead-in at the well known station 5XX, located at Chelmsford, England Note the size of the lead in insulator

um tube installation in the world has been put into operation at the naval radio station at San Diego California according to an announcement by the Radio Division Bureau of Steam Engineering Navy Department The equipment was not designed for telephone use but will be used for radio telegraph communication Messages may be sent at the rate of 100 words a minute

It was pointed out that within a few years the navy arc transmitters will probably be replaced by vacuum tube transmitters

The transmitter at San Diego is about four times as powerful as any other vacuum tube set used by the Federal Government according to the Navy's radio engineers It is capable of radiating about 80 times as much electric energy as the ordinary radio phone broadcasting station using 1 000 watts With this modern installation the Navy Department will be able to communicate directly with NSS Annapolis Maryland with the Hawaiian Islands with Japan and with the battle fleet no matter where it is cruising on the Pacific

Naval engineers say that the new station will in no way interfere with broadcast listeners

Radio Statistics

THE statistical department of station WEAF recently announced the results of a two-year survey made of broadcasting in the United States From the data collected it was revealed that of the 1 424 broadcasting stations licensed by the Government since November 1920 878 or 62 percent have ceased to function The two principal reasons for the discontinuance of broadcasting are inability to finance 45 percent, and service unsatisfactory as compared with the larger competing stations 17 percent

The survey indicated that the potential audience of WEAF and a chain of 16 other stations is more than 15 000 000 However discounting the potential audience by 75 percent there remain 3 750,000

A questionnaire was distributed to WEAF's auditors and more than 64 percent of those addressed replied The answers indicated that the average number of listeners per set is five and that 62 percent of the radio set owners own their homes Pleasure cars are owned by 46 percent pianos by 50 percent phonographs by 74 percent and about 81 percent have electricity for lighting their homes

The coverage of WEAF's network as compared to the continental United States shows that 59 5 percent of the receiving sets in the country and 50 1 percent of the total population is in range of the New York programs radiated by the chain of transmitters Seventy five percent of the people listening in live in cities and approximately 29 percent live on farms according to the survey It is estimated that WEAF's net spreads radio entertainment over 24 6 percent of the farms in the United States

Power-Supply Units

RADIO stores are now handling a variety of "B eliminators and A B-C power supply units which supply the detector plate voltage the proper amplifier plate voltage 135 volts for power amplifiers and in the case of the A B-C" units voltage for lighting the tube filaments and for the grid bias

The A B C units generally are equipped with a trickle charger using a rectifying

Herbert Photos

A radio loudspeaker. This reproducer resembles an open book. The music and voice come from the pages of the "book"

Herbert Photos

An interesting 40-meter transmitter with power of 60 watts and equipped with European type tubes. Walter C. von Brandt is seen holding one of the set's tiny tubes and a standard 250 watt tube for comparison

tube which keeps the storage "A" battery fully charged at all times. A number of these instruments are provided with an automatic relay which functions when the "A" filament switch is turned on. When the switch is snapped to the "off" position the relay automatically disconnects all power supply units from the receiver and places the storage battery on charge. These automatic relay switches are also marketed separately so that radio set owners may install them on their present equipment.

The operation of the power supply unit is explained as follows: Current flows through the trickle-charger transformer supplying current for the filament of the rectifier tube and at the same time current for the plate of the tube. There is then available at the "A" battery leads a direct current of about .6 ampere at a potential of 6 volts.

When the storage "A" battery is connected to the leads it is placed on charge. (When going away for an extended time turn off the 110-volt supply, that is, disconnect the plug from the light socket.)

As soon as the owner desires to use the radio the filament switch is turned to the "on" position and a small relay operates which automatically disconnects the "A" battery from the charger, shuts off the rectifier tube and lights the filaments of the UX213 full wave rectifier besides furnishing the tube with plate voltage. When this occurs there is from 90 to 135 volts on tap for the detector and amplifiers. "C" battery voltage is also provided at this time.

When the operator is through using the set he turns the filament switch to the "off" position, disconnecting the UX213. The rectifier tube then is lighted and the "A" battery is again put on charge.

No change in the wiring of the receiver is necessary when a current supply device is employed. The connections are made to the binding posts in the same manner that batteries are attached to the set.

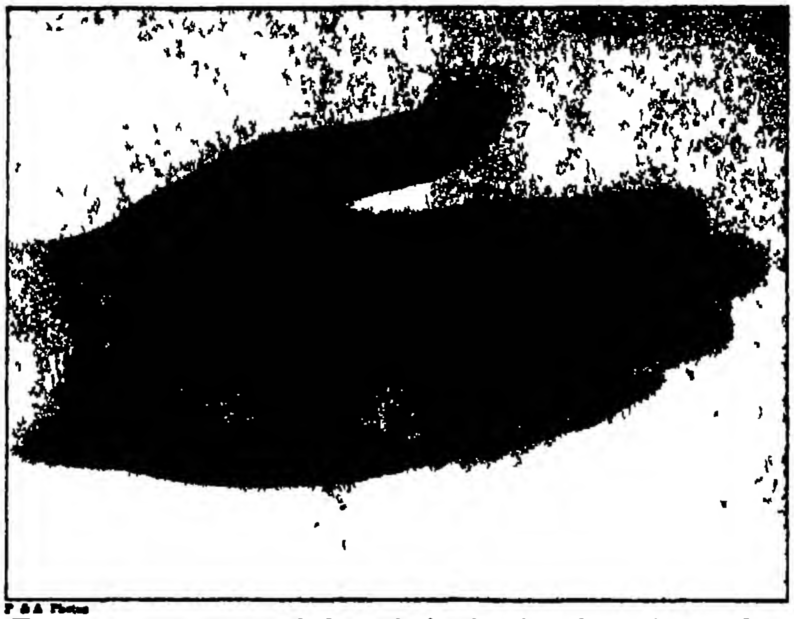
Fifteen Licenses for Research

FIFTEEN licenses to operate radio transmitters have been issued to the General Electric Company by the Department of Commerce so that the research engineers of that company may make a comprehensive inquiry into the mysteries of the ether.

Rarely are more than six transmitters on the air at the same time on the radio reservation at South Schenectady. The wavelengths are so far apart that they do not encroach upon each other and furthermore all of the transmitters are controlled by crystal quartz which holds them on the exact wavelength thus preventing interference.

The licenses are for the following stations and wavelengths: 2XAW, 3 to 20 meters; 2XO, 2XAF and 2XAD, 10 to 50

A loop antenna direction finder. Captain W. C. Hamilton of the S.S. Macom, the flagship of the Department of Plant and Structures' fleet in New York Harbor, often finds the radio compass useful when fog envelopes the bay



P & A Photo
This plywood receiving set, which was displayed at the radio exhibition at London's famous Olympia, weighs only as much as a wedding ring. It easily fits into the palm of the hand. Excellent reception is obtained from local stations

meters, 2XH 2XK and 2XAC 50 to 150 meters 2XAK and 2XAZ 100 to 200 meters, 2XAG (50 kilowatts) 380 meters 2XAH 1000 to 4000 meters 2XI general experimental license 2XAW 110 meters 2XAF 110 meters The fifteenth license is for broadcasting purposes and it is best known to the broadcast listeners It is WGY licensed to operate on 379.5 meters.

Station 2XAF is now being used on 32.79 meters for relay to Europe South Africa and Australia

702,000 Receivers in New York

An analysis made by the management of station WEAF is the basis of an estimate that in the territories covered by station in the cities listed here radio sets are distributed as follows New York 702000 Boston 380000 Philadelphia 265000 Washington 166000 Buffalo 125000 Pittsburgh 208000 Cleveland 172000 Detroit 224000 Cincinnati 187000, Chicago 354000 St Louis 146000 Minneapolis 73000 and Davenport 88000 making a total of 3090000 Based upon these figures it is believed that there are approximately 5200000 receiving sets on the United States

Volume of Mail

Mail from radio fans cleared through station WEAF's network not including communications sent direct to the sponsors of programs shows the following monthly average for each client during 1925, January 2343 February 3418 March 2894 April 2095 May 1315 June 570 July 599 August 434 September 630 October 1655 November 1236 December 1907 The heaviest mail is received from October to May inclusive

Clam-Shaped Loudspeakers

Several manufacturers of the cone type loudspeaker are building the instruments in the shape of a clam shell instead of a disk They place the apex at the lower part of the face instead of in the center as in the case of disk loudspeakers The designers contend that the new shape gives all frequencies a better chance to reproduce truly The fronts of many of the new cone loudspeakers are decorated with landscape paintings sailing ships and various other designs

Rechargeable "B" Batteries

Rechargeable dry-cell 'B' batteries have now been placed on the market It is contended that this type of battery has an original life as long as the ordinary 'B' battery, but can be recharged six or eight times at the cost of approximately 1½ cents for each charge These batteries can be charged on alternating current from any standard B battery charger or chemical rectifier Where direct current is available a rectifier is not required

Trickle Chargers

Trickle chargers are much in evidence at the radio shows this year One manufacturer said that he sold more than 200000 of these devices last season and that the demand is greater this year The trickle charger is a device which once connected to the A storage battery instead of operating intermittently at a high rate functions continuously at a low rate automatically keeping the battery fully charged In reality it converts the A storage battery into a power unit Trickle chargers are noiseless in operation and the current consumption is estimated to be approximately half a cent per hour of reception

Majority of Stations Located Here

Commenting upon the growth of the radio industry as reflected by exports Dr Julius Klein director of the Bureau of Foreign and Domestic Commerce of the United States pointed out that the majority of the world's broadcasting stations are located in this country and that the peoples speaking the English language are leading all others in the development of radio

Exports of radio equipment from the United States during the last five years have been valued in round numbers at 1000000 3000000 3500000 6000000 and 10000000 dollars for the respective years" said Dr Klein Reports from all parts of the world give constantly increasing estimates of the number of receiving sets in operation and new broadcasting stations are opening every month Steadily the legal barriers to radio development all over the world are being withdrawn and new countries are entering the field

The United States has more than three fifths of the world's stations In the number of sets per 1000 population the United States leads with 48.3 sets, followed in order by the United Kingdom with 35.6 Sweden with 30.3 and the Union of South Africa with 26.7"

Tube Reactivators

There are several vacuum tube reactivators on the market this season, prompted by the fact that detectors and amplifiers gradually lose their efficiency because the active material on the filaments is gradually consumed Manufacturers of these devices say that nine out of ten tubes ready for dis-

(*Continued on page 462*)

card can be made to give many months of service by the process of reactivation

The system is explained as follows As the filament emission of electrons becomes less and less the tube's ability to detect and amplify diminishes and the quality of reception falls off in proportion New tubes should possess high filament emission, but this constantly decreases according to the amount of use or abuse to which they are subjected In the Radiotron type of tube, the filament is of tungsten coated and combined with thorium The filament is active only when there is a layer of thorium on the surface The condition of the thorium coat governs the amount of filament emission

Operating a receiver at too high a filament voltage quickly destroys the coating The result is rapid deterioration of the tube and even at normal voltage, the filament's efficiency gradually decreases through continuous use

It is pointed out that a thorium-coated filament tube should not be discarded or considered "dead" as long as the tube lights simply because it fails to give the required results Inside each filament there is a considerable amount of thorium and by applying the reactivating process this material can be attracted to the surface of the filament, restoring the efficiency of the tube

Compass Stations Kept Busy

Radio compass stations along the American coast are becoming more and more important to navigation During the period of one month, the navy compass stations furnished 19 952 bearings of which 1,989 were for naval and 17 963 were for merchant ships Cape Hatteras is generally the busiest station

Railroad Radio

Engineers working on the development of radio apparatus for trains report that they have a number of obstacles with which to contend Bad reception spots are noticed when the train is in the vicinity of steel bridges Tunnels also cause trouble There is a perceptible roar in the loudspeakers while the train is in motion, but most of this disturbance has been eliminated by mounting the radio set on a rubber base to prevent mechanical vibrations from creating microphonic noises in the radio circuit

The American Railway Association is urging its members to encourage and cooperate with manufacturers in developing simple and reliable radiophone apparatus for use in practical road service to enable men at both ends of long freight trains to maintain constant communication

Why WGY Fades

Why do the radio programs of WGY, Schenectady, wax and wane in the other around New York? When asked to account for the fading, Harry Sadenwater engineer in charge of the technical operations of the station said, 'I am about convinced that the Hudson River is responsible for the swinging signals It seems to me that the waves travel more easily along the water and perhaps faster than over the land The differences in the speed of the waves over the land and water, and possibly an interaction between the two may cause the fading."

The "N" Circuit

An outstanding feature of the National Radio Exhibition held at Olympia England, was the "N" circuit invented by Sir Oliver Lodge It is said to represent the last word in simplicity There is one tuning condenser and a filament control Once these are adjusted an ordinary snap switch turns the receiver on or off The set is designed not to radiate

British Favor Crystal Sets

There are 1 800 000 radio set owners in England according to the number of receiving licenses that have been issued There are 20 broadcasting stations in the British Isles and 66 percent of the listeners use crystal-detector sets It is reported that the most powerful station at Daventry can be heard 200 miles away on a crystal set

Powerful Generators

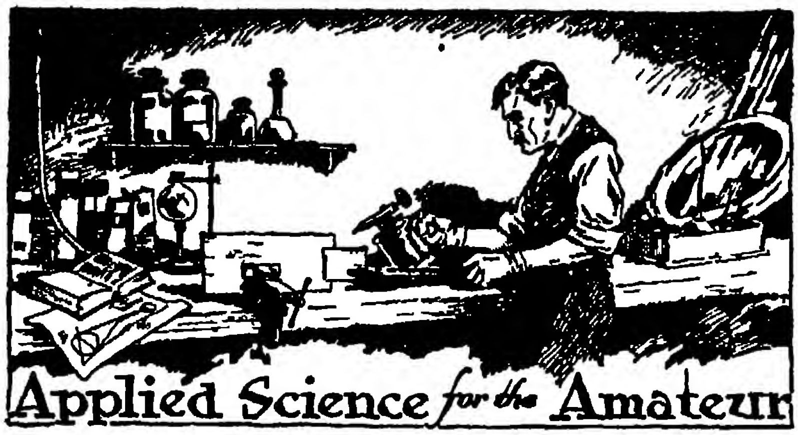
The large motor generator units which supply the current to light the filaments of the transmitting tubes of station WJZ, Bound Brook New Jersey deliver an output sufficient to light the tubes of all the receiving sets in New York City simultaneously according to engineers of the station

A Radio Voice for Uruguay

A new one-kilowatt transmitter which has been ordered for installation at Montevideo, will serve as the official broadcasting station of the Uruguayan Government.

Herbert Photos

Japanese ladies in a Tokyo garden enjoying a radio program through the medium of crystal sets which are concealed in the handle of each parasol. The metal frame of the parasol serves as an antenna



A department devoted to the presentation of useful ideas wherein will be found material of practical value for those who are mechanically inclined

Conducted by A P Peck

With this issue, we introduce a new department to our readers. In it, we want to present practical hints and kinks, formulas and processes and ways of doing things that are new, unusual or of particular value To make this department of the greatest value to all, we invite our readers to contribute Read the items in the columns below and then try to help your fellow readers by sending in some material that you think will be of general interest We will pay for all articles that are accepted Rejected items will be returned promptly when stamps are enclosed The success of this department depends on you Let us know what you think of it and be sure to do your part by contributing If you can suggest any way in which these columns can be improved, do not hesitate to do so

For the Amateur Photographer

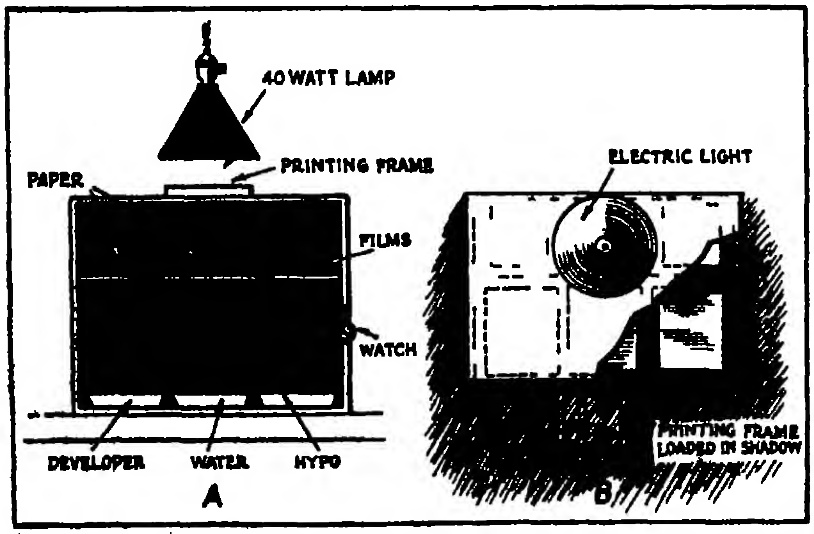
HAVE you ever seen a sign that stated that films left up to ten o clock in the morning will be delivered by five o clock in the afternoon? Seeing this, did you ever wonder how it was possible to accomplish the work that is entailed in developing drying and printing in such a short time? The answer is that carefully designed apparatus and a well planned system speed up the work While the machinery used in these large photograph finishing plants is far beyond the amateur photographer and would be of little benefit to him if he should be able to get it still some of the methodical processes followed in the wholesale finishing work may be copied with benefit

One of the simplest forms of printing arrangements that will be found suitable for the majority of amateur work is illustrated in these columns It consists of a wooden box about two feet square fitted with a shelf as shown and painted black inside Three trays one for developer one for washing water and one for hypo are placed in the lower section Films from which prints are to be made as well as various grades of printing paper of the correct size are piled up on the shelf as shown at A Above and to the rear of the center of the box, an electric light and shade are hung as in B The bulb should be rated at about 40 watts

It will be found that the shadow cast by the box will be dark enough for the loading of the printing frame The same condition also holds true with the location of the various trays Since the reserve paper is placed face down on the shelf there is no danger of its being light struck In fact the shadow also prevents this

A watch hung on the edge of the box will serve to determine the timing of exposure and development. In practice, this printing arrangement is used as follows

A film and the required grade of paper are placed in the frame which is then laid glass side up on the top of the box under the light When the proper exposure time has elapsed which must be determined by experiment the frame is returned to the shadow of the box and the paper is removed Before starting to develop the print the frame is reloaded and returned to the top of the box The paper is at once placed in the developer If the power of the light



The amateur photographer will find this cabinet very handy. When properly used, the work of printing and developing will be speeded up

is correct this system can quickly be worked out to a point where the time of exposure will about equal that of development and placing in the fixing bath Then the work can be carried on smoothly and rapidly Of course various thicknesses of negatives will tend to overbalance the system but proper attention to the developer the lighting and the grade of paper used will tend to keep the method working properly

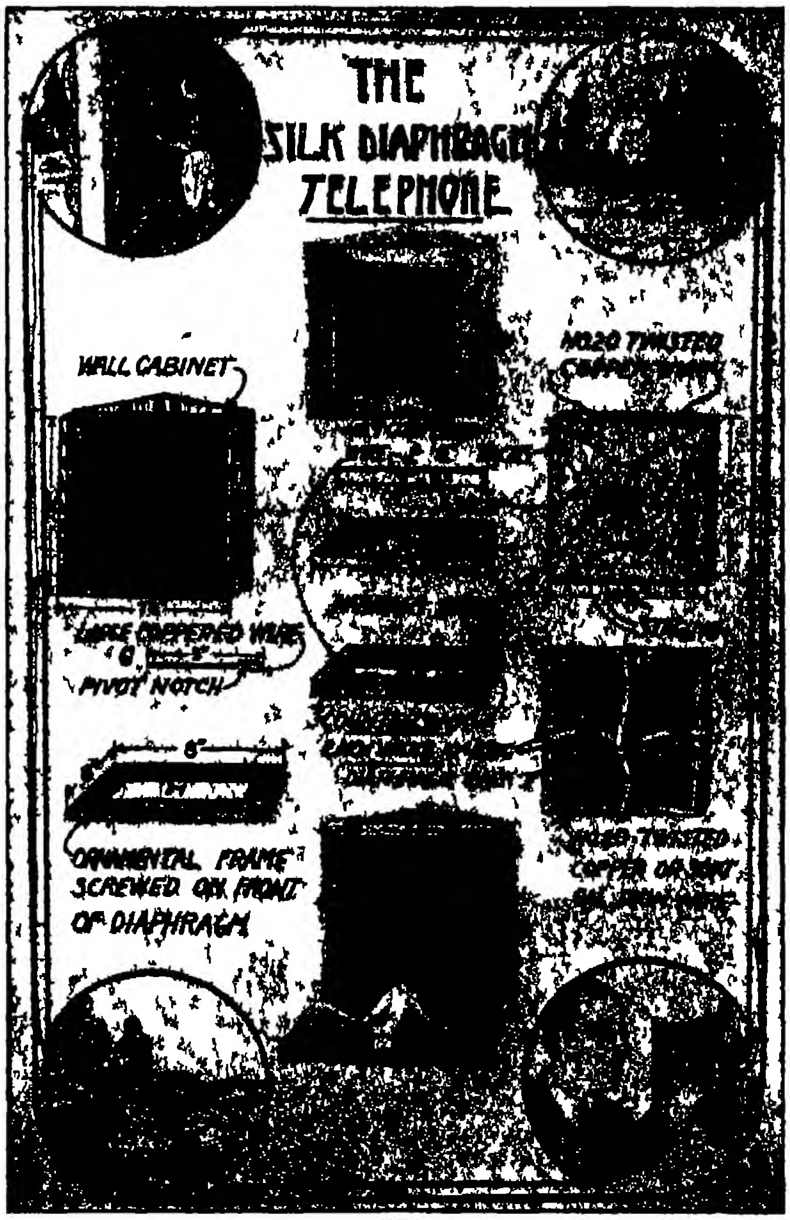
A Mechanical Telephone

THE fact that sound waves can cause a solid body to vibrate and transmit these vibrations through out its mass is not new Many of us in our toy days have used small mechanical telephones consisting of two diaphragms connected together by means of a string It is not surprising then that serious experimental work has revealed a method whereby the same principle that caused our toy telephones to work can be applied to the construction of a telephone that will operate over comparatively long distances

After trying various types of diaphragms for this purpose the writer hit upon the idea of using pure silk Investigation showed that this material must be as pure as obtainable A mixture of cotton and silk is not at all satisfactory and other materials are far inferior With two well made diaphragms constructed as detailed below and a tightly stretched connecting wire with no bends or turns in it the writer has carried on communication over a distance of approximately two miles With a right angle bend in the wire good results were obtained at one quarter of a mile The value of such a system in camps and isolated districts is obvious as the line has no operating cost and a low upkeep [One of the editors of the Scientific American built a telephone similar to this one and found it satisfactory when used over a distance of 535 feet Undoubtedly the results will vary greatly according to the materials used and the care with which the installation is made—The Editor]

The construction of the diaphragm which is to be carried out in duplicate should be done carefully following the details given in the illustration reproduced in these columns On the frame made of soft wood four holes diametrically opposite are drilled half way through as shown at D Two pieces of heavy copper wire are bent at their ends and inserted in these holes The silk cover is then tacked over the frame stretching it tightly but driving the large corner tacks only part way into the wood A piece of number 20 copper wire is then placed loosely around these corner tacks allowing enough slack for the wire to take the form shown at B when the staging is placed The corner tacks are then driven home

The next step is to turn the frame over and tack two ten inch strips of number 1 lamp wicking in place as shown at C The silk is now perforated at eight places and staging or heavy shoe string is threaded through the holes and around the lamp wick and the wire on the face of the diaphragm It is then tied in place as at C If the



The silk-diaphragm telephone, shown in detail above, holds much of interest to the experimenter The principle might be applied to radio loudspeakers

slack allowed in the front wires is correct and the staging is pulled taut, the silk surface will be as tight as a drum head and in ideal condition for the purpose for which it is intended. The frame H should now be screwed to the front of the diaphragm support.

After the protecting box, A, is made, allowing a depth of four inches, the line wire is brought through the wall, being careful that it does not touch the sides of the hole, and is fastened to the intersection of the wicks. It is then stretched taut to the first insulator and this tightness is preserved throughout the line. Remember that right-angle bends in the wire will reduce the effective length over which communication can be carried on. While copper wire is to be preferred, soft iron wire can be used to reduce the cost. Stranded wire is found best.

For calling, the heavy wire G pivoted in the side of the box, is shaken violently against the line wire causing both diaphragms to give forth a loud rattle.

The two photographs in the accompanying illustration show one of the telephones that the writer built and used with the results mentioned above.

Contributed by Tud Garver

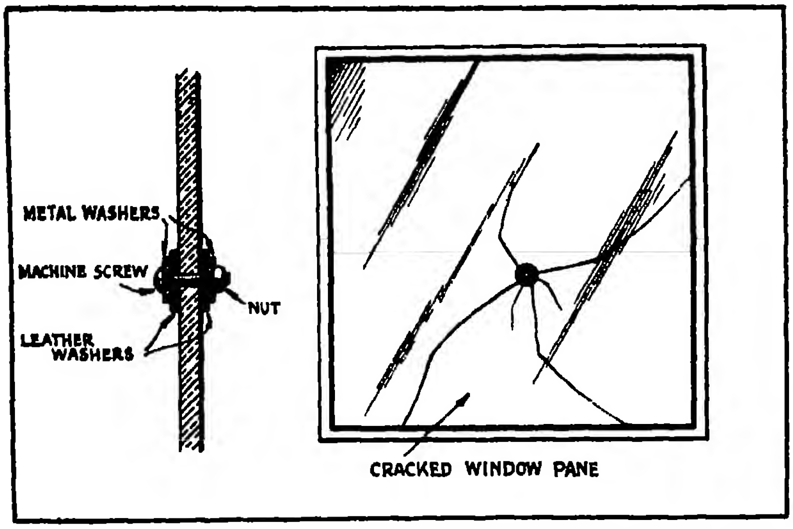
[Editor's Note: This contribution puts forth a pretty problem in acoustics and in the transmission of mechanical vibrations along a metallic wire. As the author points out, the material used in the construction of the diaphragm enters largely into the proposition. It would seem that a series of experiments along this line would be intensely interesting and there is a possibility of improving the results. If any of our readers in using one of these mechanical telephones, finds any noteworthy results we will be glad to hear of them. In a letter to the editor, the author suggests that the findings with the silk diaphragm may be applied to radio loudspeakers. Why not try it and let us hear of the results?]

Broken Window Repair

When a pane of glass cracks and there is not time or the facilities to install a new one, the following kink will come in handy. When a window is broken by reason of a blow, there are usually several cracks formed, radiating from the point where the pressure was applied. Examination will show that there is probably a small hole at the intersection of these cracks but if such is not the case, a hole can be made, and made with safety if care is taken.

Regardless of how the hole is obtained it is necessary to the use of this repair stunt. The only requisites are a small machine screw, two leather washers and a nut to fit the screw. As shown in the illustration, one of the washers is placed on the screw, the latter is pushed through the hole in the glass, the other washer is put over the screw and the nut is spun home. The nut should be tightened sufficiently to hold the broken pieces of glass in position. If the hole in the glass is comparatively large the leather washers should be backed up by two metal washers, one under the head of the machine screw and the other under the nut as shown.

If no leather washers are at hand they can easily be cut from a scrap of leather or the side of an old cast-off shoe. For the sake of neatness, they should be cut round. The hole in the center should be cut just large enough to slip over the machine screw to be used.



A cracked window pane is dangerous, as the pieces may fall out of the frame. Here is a way to prevent such a happening

Preserving the Storage Battery

The storage battery in the electrical radio or physics experimental laboratory is one of the items that does not receive as much attention as it should, and as a consequence it is the one accessory that is liable to go wrong just at the time that it is most needed. If however the following suggestions are heeded, the battery may be expected to deliver the best possible results at all times.

Absolute cleanliness should be observed in the care of storage batteries of the lead plate type. If moisture and dust are allowed to collect on the tops of the cells the result will often be that the terminals will be connected through a rather high resistance (the dampness and dust) and the battery will in a short time, be totally discharged. This condition is often hastened by carelessness when adding water to the cells. While this water is or should be distilled a conducting path is formed when the water mixes with dust on the top of the battery.

When it is noticed that the battery looks grimy moisten a clean cloth with ordinary household ammonia water and carefully wipe off the tops of the cells. Work around the terminals and under the connecting straps.

Storage battery terminals should never be allowed to become corroded. When the bluish or greenish tinged mass appears denoting that corrosion is at work remove it with a knife blade or similar tool. When the metal has been scraped bright at each terminal, coat it with vaseline or other heavy grease. This will delay the action of corrosion.

These together with the usual precautions of regular charging and addition of water, will be of great assistance to the battery and will prolong its life.

Loosening Stubborn Stoppers

When a glass stopper in a bottle becomes stuck, do not try to force it, as you will be apt to break the bottle. Instead, light a match, tip the bottle slightly and very carefully apply the flame to the neck. Rotate the bottle so that no one part of the glass will get too hot and crack. The heat of the match will expand the glass of the neck and so loosen the stopper.

Aircraft are being put to use in peace as well as in war. This department will keep our readers informed of the latest facts about airships and airplanes

Conducted by Alexander Klemin

In charge, Daniel Guggenheim School of Aeronautics, New York University

The National Air Races

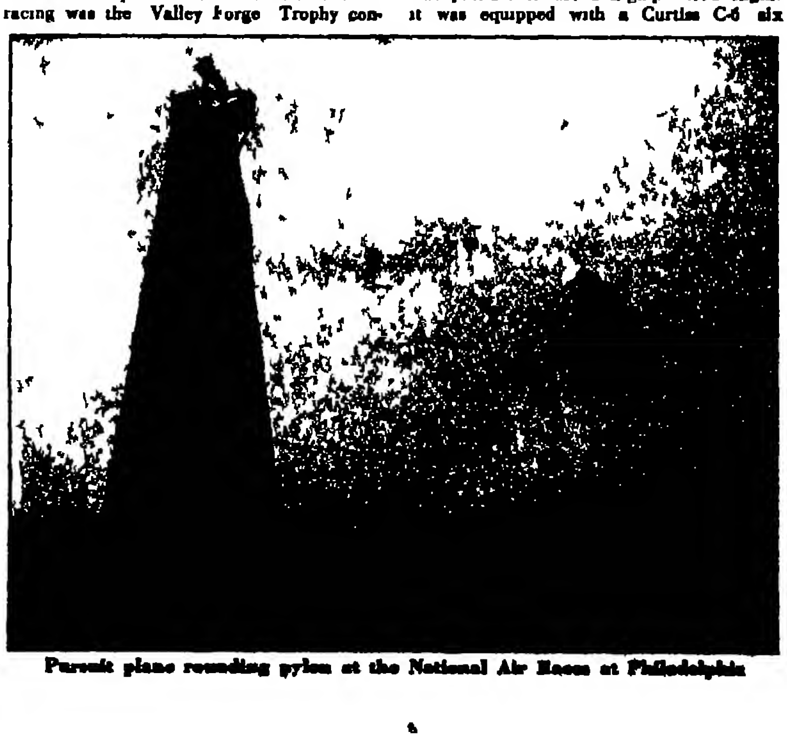
THE National Air Races held at Model Farms Field, Philadelphia, during the week of September 4 to 11 proved disappointing in spite of the many events, handsome trophies, valuable prizes and long preparation. Bad weather and poor drainage caused an annoying break in the series of events. There were no real racing planes present to make another world's record such as we used to associate with the Pulitzer trophy. There were no radical developments noticeable in either planes or engines and there is always a real difficulty in making any long drawn out air plane meet interesting. An itemized recital of this year's events would read just like that of last year's races.

There were, however, a few interesting novelties. For the first time in American air racing there was a parachute contest, Special Event B, which provided a daily thrill for the spectators. The parachutists jumped from an altitude of 1500 feet on a day and tried to get as close to a given mark as possible. Fifty dollars was the daily reward for the best attempt. The final prize of 250 dollars went to W. B. Baird who made the week's record by landing only 89 feet from the mark. The contest has a practical utility. It is not sufficient for the parachute jumper to land at a moderate rate of speed; he must to some extent be able to guide himself and avoid tree tops, church steeples and other obstacles!

Another departure from conventional air racing was the Valley Forge Trophy contest in precision landing. The trophy was the gift of Dr. Thomas F. Eldridge of Philadelphia. Contestants were required to climb to a height of 1000 feet, cut their motors and glide for a chalked circle. The weather was gusty and fliers had to adopt a variety of flying devices, some making a long glide close to the ground, others killing speed by fish tailing. In spite of unfavorable conditions the fliers all landed but a few feet short of the mark. Douglas Davis won the contest in a Waco by landing only five feet from the circle. Such accuracy is of interest in commercial flying, particularly in restricted territory.

The real difficulty in racing is that the spectators see plane after plane coming round the pylons with monotonous regularity, have to wait so long for the final result and do not see a neck to neck finish very often. However, one novelty gave them something more to see. This was the Benjamin Franklin Trophy relay race in which three teams of three planes each were entered. After making one lap of the course a plane of a given team would land as near a certain flag as possible; the passenger would get out, grab the flag and run back and tie the flag to the next plane of his team as rapidly as possible. The winning team consisted of Basil Rowe and Casey Jones, each in Thomas Morse planes, and A. H. Kreider in a Waco 9.

A striking incident was the changing of the engine on the Pitcairn *Sesqui Wing Arrow*. Designed for a race in which it was possible to use a high powered engine it was equipped with a Curtiss C-6 six

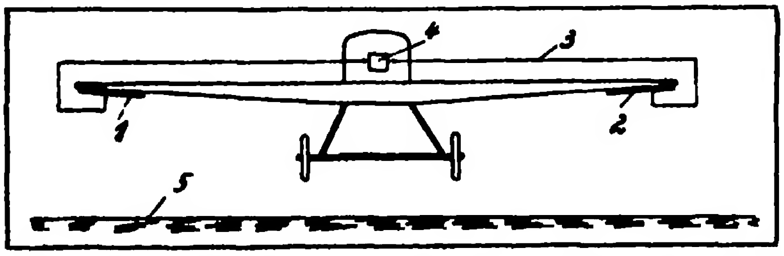


Pursuit plane rounding pylon at the National Air Races at Philadelphia

cylinder vertical engine Then the owners of the plane decided to enter it for a race where only an engine of 510 cubic inches displacement could be used and an OX-5 90 horsepower engine, an eight cylinder V, had to be substituted accordingly To make the change a rough wooden scaffold was erected on the field with a steel cross beam on which ran two heavy tackles one for taking the engine out and one for putting it in Ingenious devices for centering the engine and for changing the ignition instruments and fuel and oil connections allowed the whole operation to be accomplished in 31 minutes Such methods are of immense interest to air line operators as they show that the removal of an engine for repair or overhaul will not immobilize a plane for any length of time

Perhaps the most striking points about the meet in general were the disappearance of old war time types Not a "Jenny" and but one old time Standard were present The OX 5 engine was present on many planes but the more modern engines such as the Wright Whirlwind were seen in equally great numbers The efficiency and reliability of air cooled engines received another endorsement Perhaps 90 percent of all fuselages on the field were of the steel tube type There was steady progress all round even if there was nothing startling

At the close of the races there was a demonstration of The Voice from the Sky On the underside of the Sikorsky S 29 was fitted what looked like a loud speaker



A height indicator which operates on the principle of a condenser; the capacity between the plates 1 and 2 and the ground 5 changes with the height

With engines throttled and at an altitude of about 1 200 feet the voice of one of the crew singing a popular song could be plainly heard by the crowd Perhaps there is in this the possibility of another advertising method

Suggestions for Future Races

IT seems amply demonstrated at the recent National Air Races that small planes can be built to have the efficiency of racers and to be perfectly airworthy In the 300 cubic inch classification for next year s races it would seem to be a pity to ask for speed and nothing else Surely it would attract more interest and serve general development better if two seaters were insisted upon Also following the example of the British light plane meet at Lympne why not include tests of the rapidity of disassembly and re-assembly and allot points for the dimensions within which the planes can be housed

The race would thus serve a more useful purpose and lead up to sales to the general public A test of the ability to clear a 25 foot barrier after a 300 yard run would also enhance the value of the race, since it would involve a feature of considerable importance to the safety of airplanes when making get aways in restricted fields Perhaps the authorities of the National Aeronautic Association will give some attention to these points in the near future

A Height Indicator

THE Army Air Corps has been experimenting with a height indicator for several years. This device functions when the plane is approaching the ground and should be particularly useful in fact almost indispensable, when flying in fog From *Flugsport* it would appear that the Junkers Company has taken out patents for a similar device This is shown diagrammatically in these columns At the two ends of the wing are placed horizontal metal plates 1 and 2, of large area connected by a wire, 3 at their ends The two metal plates thus form the elements of a condenser of very slight capacity When the plane approaches the earth the capacity of these plates increases very rapidly because the earth itself is a conductor If the plates are therefore part of an oscillating electric circuit the variation of capacity on approaching the ground can be readily made to give a warning signal by methods familiar to radio engineers

Planes of Limitless Size

MANY authorities believe that the air ship because of its load carrying capacity and long range will ultimately be the means of fast transportation across the Atlantic On the other hand a number of German constructors are convinced that they can develop the airplane to the point where it will be capable of crossing the ocean at even greater speed than the air ship carrying sufficient fuel and a commercially profitable pay load of passengers and cargo without such overloading of the wings as was necessary in the ill fated Sikorsky S 35

The problem is not an easy one It is not enough merely to increase size For geometrically similar airplanes with the same landing speed the lift increases as the square of the span or any other linear dimension while the structural weight increases as the cube of the linear dimension In theory therefore the structural weight of the airplane will bear a larger proportion to the gross weight of the craft as the dimensions increase Ultimately a point is reached where the structural weight so much that no surplus remains for carrying fuel much less pay load

In practice the theoretical law does not apply because with large craft the maneuvers are not so violent high factors of safety are not so necessary and many devices in design allow the weight of the large plane to be kept down But it will apply finally for really huge craft such as have not been attempted hitherto

How then are we to build giant planes in which the structural weight is to be kept down? Roughly speaking the wings of an airplane are analogous to a cantilever bridge As the span of the wing increases so does the bending moment at the root of the wing where it attaches to the body Increased bending moment means more material in the spars and more weight Therefore why not have several fuselages and distribute the load all along the wing? Surely this will relieve the strains and lighten the structure The idea of distributing the load along the wings is not novel and has been suggested in many quarters

Dr Rumpler a well known German constructor has carried the idea beyond the suggestion stage and worked out in detail a design which is of real interest His plane is shown in its suggested form Instead of the customary one or two floats as in the conventional seaplane he proposes to use six floats, four of which are to extend to the tail control surfaces This is the first step in load distribution and diminution of the bending moment strain. Further, instead of one concentrated engine and fuel load, ten engines of 1,000 horse

The Rumpler multi float seaplane By the principle of distributing loads along the span, the weight of the structure may be considerably reduced

power each are to be disposed along the length of the wing with fuel tanks like wise distributed the engines driving ten propellers through gearing (The engines and fuel will be in the wing and the gear and shafting-driven propellers are to be disposed in tandem between the floats) The passengers are to have their quarters inside the wing which will be large enough to provide sufficient room for living sleeping and dining Passengers and cargo are likewise to be distributed along the length of the wing

According to Dr Rumpler this principle of load distribution will so lighten the structure that instead of the usual 35 per cent the plane of limitless size" will have 50 percent of its gross weight in useful load (that is fuel oil and cargo) Therefore it will have ample fuel for crossing the Atlantic in an uninterrupted flight and to carry a real pay load at the same time

Besides the advantages of range and pay load greater security is claimed for such a type of craft With ten engines each with a separate fuel system it is inconceivable that power plant troubles should ever bring the seaplane down The large number of floats and its huge dimensions will make it seaworthy in the roughest sea Mere size will increase its stability in the air as well as its seaworthiness

The design is so well worked out that it is possible to regard the data accompanying the plans with confidence The gross weight is to be 253 000 pounds the pay load is to be 44 000 pounds including 130 passengers with 13 200 pounds of baggage mail and express matter the fuel load is to be 81 700 pounds sufficing for 16 hours flight at full throttle with ample reserve or for 27 hours at a cruising speed of 125 miles per hour giving a range of some 3 375 miles The wing area is to be over 10,000 square feet and the span nearly 300 feet.

Perhaps this superplane is not so many years distant

An Airplane Wheel Brake

THE application of brakes to airplane wheels is proving very useful They shorten the landing run do away with the necessity of ground tackle or of men hanging on to the wings at the start of the plane and when acting independently on either wheel facilitate steering on the ground The Sauzedde Wheel Company has now brought out a wheel for airplanes in which the brake mechanism is an integral part of the wheel This arrangement is now in use on several types of planes The wheel is of light construction with spokes, hub and axle of an alloy composition There are three banks of spokes, 32 in one and 16 in each of the other two The brake mechanism is self-energizing and operates with equal force during forward and reverse motion of the wheel A wire usually enclosed in the steel-tubing struts of the landing gear transmits the force to the brake from the rudder bar pedal

Signaling the Airman

THE British Imperial Airways operating between London and Paris shows a freedom from accident which is definitely superior to the record of any other European air line This is due partly to the excellent equipment and partly to the splendid ground organization which is being constantly improved

While all British transport planes are equipped with radio receiving and trans-

A wire wheel for airplanes, in which a brake is incorporated, is shown above. The feature of the brake has many advantages for the airman

Signs used at English airdromes to signal weather conditions to airmen

nitting sets and obtain information on the weather at any time, a system of visual weather signaling to the pilot has long been considered desirable. It is only recently that a simple yet effective system has been devised. On the various English airdromes huge signs are now installed, consisting of hinged "doors" which can be opened or closed as desired. The sign at the top left of the device above, means rain or drizzle, top right, snow, hail or sleet, bottom left, thunderstorms or line squalls, and bottom right, gales. The men in the lower photograph are shown busily shutting down the signs.

A Neat Touring Plane

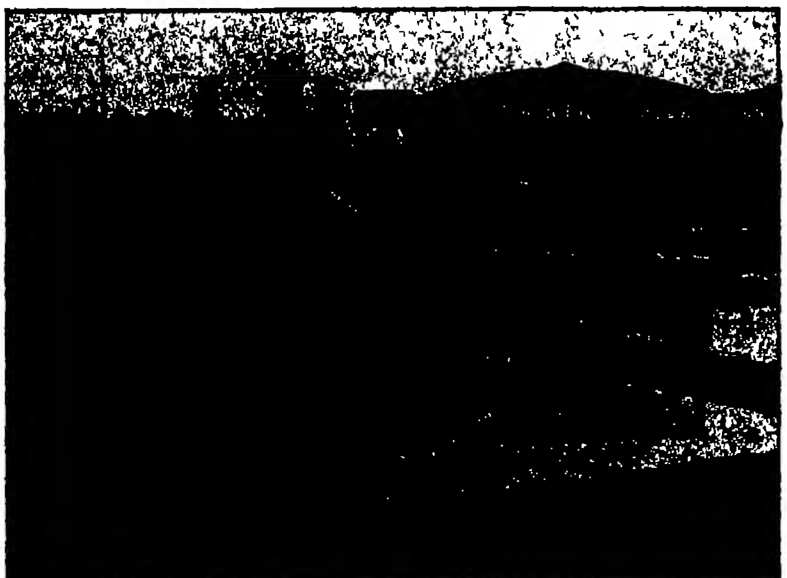
THE Focke Wulf twin-engine touring plane which has recently passed its flying tests at Adlershof, Germany is one of the neatest designs to be seen either in the United States or abroad. Its wing is a monoplane, entirely without external bracing and of exceptionally good aerodynamic form. The engines do not form an unsightly protuberance above the wing, nor are they supported by a more or less complicated structure of tubing; they blend perfectly into the wing itself, disturbing the air flow to a minimum degree. The engines are air-cooled, yet no projecting cylinders are in sight; they are the Junkers type L1 of 75 horsepower, in which the air is drawn in at the front end by a blower mounted on the propeller shaft, and then guided in special passages so as to give uniform cooling to all six cylinders (as recently described in our columns).

The pilot is seated where his vision in all directions is excellent, but he is fully protected by a windshield which can slide up or down, and is *not* at the very front end of the machine where the main impact of a crash is felt. Three or four occupants can be comfortably seated in the passenger cabin.

A great deal remains to be done in the problem of eliminating noise in the passenger cabin. The Focke Wulf plane shows a step in the right direction by providing a double veneer wall for the compartment so that it is insulated from noise.

We have become so accustomed to the long, stilt like landing gear of all types of airplanes that it is a relief to see a cantilever form of chassis with solid stubs projecting directly from the sides of the fuselage in a horizontal plane. The resistance of the chassis to the air stream is thus reduced to a minimum. This landing gear design has still another advantage, since the engines are mounted in the wing, there is enough propeller clearance and yet the fuselage is but a foot or so from the ground. The passengers have only a step to make to get into the cabin and the tendency to nose over on landing is slight, because the center of gravity is not high above the ground.

The propellers swing forward of the pilot's head. When propellers break, the thrust which is present on the blades carries the released elements forward and sideways. There is no guarantee, even in this design, that breakage of the propellers may not injure the pilot, but at least the danger is minimized.



The weather signs are made to disappear by the simple process of turning the various large "doors" about their hinges

From the Office of

Mrs. Ballington Booth
34 West 28th Street
New York City

December 1, 1926

To the Editor
Dear Sir

Will you allow me through your columns, to appeal to your readers once more on behalf of the wives and little children of the men in our prisons.

My close touch with the prisoners of this country brings me more and more into contact with these many needy families. We try to make our Christmas gifts most practical. Something that will last through the winter not only for the brightening of one day. Therefore in addition to Christmas cheer and toys we send warm new clothing and hundreds of pairs of shoes for the little feet that must tramp to school through mud and snow and which but for our help would be poorly shod.

Will the readers of this message help me? We try to make every dollar go as far as possible. Checks, clothing or toys should be addressed to Mrs. Ballington Booth, 34 West 28th Street, New York City.

I might add that The Volunteers of America is a duly incorporated organization, that our accounts are carefully kept and audited and receipts sent out for every gift.

Believe me,

Very truly yours for our Country's prisoners,
MAUD BALLINGTON BOOTH

The Focke Wulf touring plane of exceptional design. The cantilever chassis brings the fuselage close to the ground. Such a plane, with its enclosed cabin, is bound to make a strong bid for popularity

We have often emphasized the possibility of making a long glide with one engine of the two not functioning. The Focke Wulf plane fully loaded with pilot, three passengers, 145 pounds of baggage and fuel for three hours flight at full throttle has made a flight on one motor of nearly five miles and lost only 300 feet altitude in the process. This plane certainly seems worth careful study by American designers.

Learning to Fly

THERE are hundreds, perhaps thousands of young men in the United States who wish to learn to fly, some because they wish to become professional pilots and air operators, some because they wish to acquire a modern and useful accomplishment and to feel the thrill of man's latest achievement over nature. To such men a variety of plans are open. They may proceed to one of the many excellent flying schools now found in every part of the country and for a few hundred dollars learn to "solo" in ten or fifteen hours instruction and in many instances acquire also the rudiments of the mechanics of plane and engine.

The difficulty with the graduates of such schools is that their brief flying training does not fit them for really responsible flying work. If they choose, however, to enlist in the Army Air Corps, they may secure far more comprehensive instruction involving several hundred hours in the air and be paid while in training.

A book issued by the Ronald Press, "Aircraft and Airmen," by Major Henry H. Arnold gives a very faithful picture of the training which may be secured in this service and is also a most interesting introduction to flying in general. Before being accepted for the physical examination a candidate must show that he is unmarried, a citizen of the United States, between the ages of 20 and 27 years, a high school graduate or of equivalent education and of excellent character. If he complies with these requirements he may be ordered to report at one of the active aviation fields where is given his physical examination. This is the most severe ever devised and includes every part of the body. Special attention is given to the ears and eyes, to the sense of balance and to quickness of reaction. A mental examination follows except for those men who have graduated from high school within the two preceding years.

After passing both the physical and mental examination the candidate is assigned to the United States Army Primary Flying School at Brooks Field, San Antonio, Texas, starting with his class either in March or September. A flying cadet enlists for a period of three years, but is discharged either upon completion of the entire flying course of one year or upon failure to complete the course. As a cadet, he receives pay of 75 dollars a month and additional dollar a day for food.

Major Arnold is thoroughly familiar with every phase of Army flying. He gives a most vivid picture of the cadet's training and fascinating although arduous duties. The first few days are devoted to military exercises and the development of the soldier's viewpoint. On the twenty-fifth day the class is divided into sections of six cadets. Each section is assigned to an instructor for flying training. "Naturally the first airplane ride is an interesting event for every cadet," says Major Arnold. "Many are afraid that they will not like the ride or become scared or get sick in the air, but upon landing from the first flight the wonder is why they had any fears at all. It was enjoyable—so different from what they had anticipated."

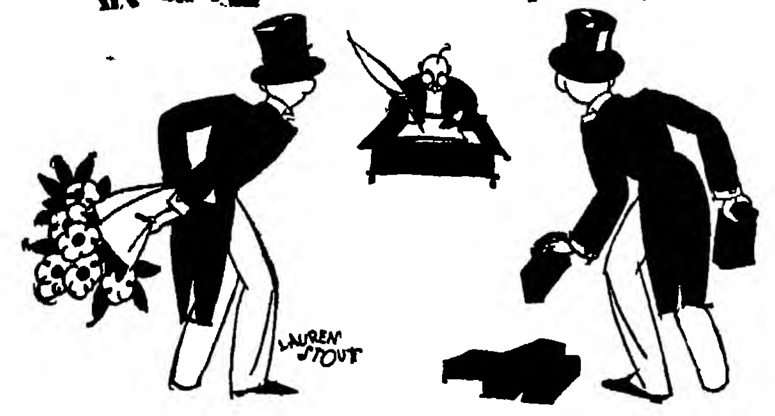
Daily flying instruction occupies about three-quarters of an hour. The remainder of the morning is devoted to servicing planes, cranking engines, trouble shooting and similar duties. The student absorbs considerable mechanical information in the process.

In the actual work in the air, the instructor sits in the front cockpit and the student in the rear, both having a complete set of controls. At first the student is given the joy-stick for elevator and aileron control and told to keep the plane flying on an even keel. The pupil over-controls at first, causing the plane to wobble and jump. The use of the rudder comes next. After he has learned to keep the ship on an even keel and on a straight course he makes gentle turns, then sharp turns and figure eights. Then follows the painful process of making landings, the student lands again and again until he has mastered this difficult art.

Then comes training in spins, Immelman turns, et cetera. At the end of some ten or fifteen hours instruction the student makes his first solo flight. "The student is not given an opportunity to worry about the prospective solo flight," says Major Arnold, "because when the student least expects it, the instructor will jump out of the plane and say 'take it up by yourself.'" The student then receives instruction in "precision flying," ground instruction in radio, gunnery, engine and plane assembly and disassembly and finally graduates in about six months. He then goes on to the Advanced School at Kelly Field, Texas, where he passes from the training plane to advanced service types, and applies his knowledge of flying to specialized work in Army observation, bombardment and other military branches of aviation.

A man who qualifies at the end of the year is not only a reserve officer of real value in the scheme of national defense, but a man whom commercial aircraft operators have learned to respect and often select for both flying and for ground work in connection with various commercial services.

IN THE EDITOR'S MAIL



To Increase Subway Service

In several cities, the problem of relieving congestion in subways has become large. In New York City it has been proposed that the station platforms be lengthened and more cars run in each train. Of course, this would help to a very great extent, but the cost is huge. To solve this difficulty and to allow the use of longer trains with the present platforms, one of our readers has evolved a train plan that is explained in the letter reproduced below.

Editor, Scientific American:

The plan for subway trains that I have designed and upon which I have been allowed a patent may be described in the following manner. The trains are longer by one half, and divided into three sections, each of which is marked in a distinct identifying manner. Each station is divided into two sections, marked to correspond with two of the train sections.

The operation of the plan is as follows. The three sections of the train may be marked with red, white and blue. Then each odd station will have one half of the station red and the other half white. At this station the red and white sections of the train will stop at the platform and the blue part will be in the tunnel. At each even station the white and blue sections of the train will align with the platform and the red part will be in the tunnel. With proper posting of directions for passengers the plan can easily be worked out at a great saving to the transit companies, and with a huge increase of rush hour service.

Robert H. Rippere,
Brooklyn, New York.

Suspicious Humanity

A little while back, the magician, Houdini, allowed himself to be sealed in an airtight coffin and sunk beneath the waters of a swimming pool in a New York hotel, as a guarantee that he had no secret access to air. He came out one hour and 31 minutes later, alive but rather exhausted. He was trying to show, he said, that a person while relaxed and quiet breathes very little air, and that the previous attempt of a Levantine to perform the same feat on a self-asserted basis of "going into a trance" was insincere. In spite of these facts, many people believed Houdini took compressed oxygen into the coffin with him, or did some similar "stunt." In the following letter the manufacturer of the Pulmotor refutes these assertions. Houdini had no need to resort to tricks. There was air enough in the coffin provided he kept quiet.

Editor, Scientific American:

I have just been doing some figuring with the data before me regarding the recent trick performance of Houdini. It is possible that you may be interested in a brief résumé of the matter.

I am informed by the Rockefeller Institute that the specific gravity of the human body is approximately 1.0. The dimensions of the case in which Houdini remained were 6½ by 2½ by two feet, according to the figures given to me. I have assumed that Houdini's weight was 180 pounds. This indicates that there were 29.578 cubic feet of air available in the case after deducting the space occupied by the body.

According to Henderson and Paul in their Technical Paper Number 82 for the Bureau of Mines, the average volume of oxygen consumed by a man resting in bed is 0.237 liters per minute. In order to allow a liberal margin for the possibility of any excitement which might be caused by an undue nervous strain of a man under the circumstances in which Houdini was placed during this test, I have increased this consumption of oxygen to 0.3 liters per minute.

If I recall the results of the test correctly Houdini remained in this case for 1 hour and 31 minutes. I have made this 1 hour and 40 minutes, to be liberal again.

With these figures it would appear that a total of 30 liters of oxygen were consumed during the test. By converting the above number of cubic feet, namely 29.578, to liters, we have approximately 837 liters of air available, or approximately 176 liters of oxygen. About 17 percent or 30 liters of this total oxygen was thus consumed during the test, and approximately the same amount of carbon dioxide given off. There was approximately 21 percent of oxygen in the air originally, therefore 3.5 percent of the total amount of air was apparently used in this test. If you will refer to page 25 of Technical Paper Number 82, you will notice that, "the blood of a normal man or animal at sea level is unable to absorb oxygen fully when the proportion in the atmosphere that he is breathing falls below about 13 percent." In this case, however, the figures would indicate that there should have been over 17 percent remaining. If you will further refer to the report on pages 28, 29 and 30, you will see the effects of insufficient oxygen, and on pages 30, 31 and 32, the effect of carbon dioxide on inhalation.

It would appear, therefore, that the theoretical percentage of oxygen and carbon dioxide which remained at the end of the test by Houdini are well within the range of possibility without there being the slightest bit of trickery involved. I think that the only reason that Houdini was unable to remain longer under these circumstances was due to the fact that his system had been gradually accumulating the toxic effect of the carbon dioxide for a considerable period of time, which made it impossible for him to breathe any longer with safety, owing to decreased vitality.

F. F. Morris, President,
American Atmos Corporation.

Credit Where Credit Is Due

Since the publication of the October issue it has been brought to our attention that three of the excellent mural paintings which we reproduced in connection with our digest article "Mastodon or Mammoth" (page 289), and which we credited merely to the American Museum of Natural History, were the work of the well known painter of animals, Mr. Charles R. Knight.

The reader with scientific inclinations, when he comes to New York will quite likely visit this great museum. Here he will see the originals of Mr Knight s paintings—which were made under the supervision of Dr Henry Fairfield Osborn the noted paleontologist—adorning large expanses on the walls of the exhibition halls. Most of them depict extinct animals in their reconstructed environments The combination of an artist with scientific leanings helped by a scientist of artistic leanings assures the public that the details are as authentic as our present knowledge permits

A Tame Humming Bird

It is seldom that one hears of the capture and taming of one of these elusive little creatures that have the faculty of being able to remain practically stationary in the air suspended by wings that are moving so rapidly as to be almost invisible However we have a record of such an occurrence in the form of the letter printed below A photograph of the humming bird appears in these columns

Editor Scientific American

On May 13th of this year my daughter picked up on the sidewalk three blocks from home a very young humming bird that evidently had fallen from the nest Failing to locate the nest she brought it home The problem of feeding was solved by putting a few drops of honey weakened with water in a flower the flower being held close to the bird s beak It soon learned to drink out of a small cup

As soon as it was able to fly (in about

A tame humming bird hovering at the edge of a cup Note that the wings are almost invisible

three weeks) it was released to make its own living but it returns to the screen door three or four times a day since it was released and calls to be fed

The photo shows the bird supporting itself by its wings while feeding from the cup Occasionally however it settles on the cup to feed When first released other humming birds helped feed it However it will not allow the other birds near the cup

For about two or three weeks after it was first released the bird returned to the house every night to sleep

(Mrs) Frank Minter
Ontario California

Cows and Milk in Florida—a Correction

The Scientific American Digest recently carried an item that dealt with an interesting problem in railroad car construction The car that was described was so built that fresh milk could be transported over great distances One of the tests that was mentioned was the carrying of milk from Wisconsin to Florida a project that is surely worthy of note. However one of our readers took exception to some of the statements in the article and we are glad to publish his letter in order that any mistaken impressions that may have been formed will be corrected

Editor Scientific American:

In the October issue of the Scientific American there was an article with a picture of an insulated refrigerator car for carrying milk from Marshfield, Wisconsin to Miami Florida The heading of the article was Shipping Milk 1,800 Miles to Market" The article went on to say that cows do not thrive in Florida and that fresh milk is 35 cents a quart, and that the supply is limited

While we know that you cannot keep an absolute check on all such statements the statement that cows do not thrive in Florida and that milk is 35 cents a quart cannot go unchallenged I have seen Wisconsin, Michigan Washington and New England cows but I have never seen finer looking or healthier cows than the ones in Palm Beach County Milk is not 35 cents a quart in Florida In fact it is 24 cents a quart That is high enough without adding the extra 11 cents per quart

Sincerely
Lake Worth Chamber of Commerce
Alvin E Gillett Secretary

Relativity

Mr James O G Gibbons a consulting engineer of 207 Market Street Newark New Jersey sends us the following observations on relativity Perhaps some of our Einsteinian readers will be willing to discuss this matter with Mr Gibbons

Editor Scientific American

I have no doubt that many people who like myself have taken some interest in the Einstein theory of relativity have experienced considerable difficulty in understanding the statement that light always travels at a constant speed relative to an observer irrespective of whether he is himself in motion or standing still relative to the source of the light

The usual explanations may be quite satisfactory to those who are accustomed to deal with the more intricate mathematical conceptions, but to ordinary mortals like myself they are not very helpful

In view of the above I have worked out the following which seems to bring the case more within the realm of every day experience and I should very much like to have your opinion or the opinion of your readers as to the validity of the argument

Let A and B be two motor shafts A being under control, both as to speed and direction and B revolving at a constant speed of 2 000 revolutions per minute

If we had instruments which would not indicate a speed of more than 1 000 revolutions per minute and ran shaft A at that speed we should judge from the readings of our instruments that both shafts A and B were running at 1 000 revolutions per minute

Assuming that there was no possible way in which we could indicate or observe a speed greater than 1,000 revolutions per minute we could never know that shaft B was really revolving at a speed of 2 000 revolutions per minute

Now the speed which we are measuring is relative In this case the speed of the shaft relative to the bearings of both shafts or if shaft A be stopped we can say that our observation shows that shaft B is revolving 1 000 revolutions per minute relative to shaft A

Let it be assumed that our instruments are of such a nature that they will indicate relative speeds not exceeding 1 000 revolutions per minute under all possible conditions

We have already observed that shaft B is revolving 1,000 revolutions per minute relative to shaft A when it is at rest in its bearings We will now cause shaft A to revolve at 1 000 revolutions per minute in the same direction as shaft B Upon applying our instruments we shall be surprised to observe that they are indicating not only that shaft B is revolving at a speed of 1 000 revolutions per minute relative to the bearings but that it is still revolving at the same speed relative to shaft A, and if we should reverse the direction of rotation of shaft A our instruments would still give the same indications as to the relative speeds of the two shafts.

In other words we should have to conclude that shaft B always revolves at 1,000 revolutions per minute relative to any other object, regardless of whether that object were itself revolving or not.

Of course in this case we immediately recognize that our observations are falsified by the limitations of our instruments. At the same time we must not overlook the fact that we can never observe anything but the appearance of things, and whether the appearance of things ever does or ever can, coincide with the reality of things we probably can never know.

In the case of light we are asked to believe that light travels at a speed of 186,300 miles per second relative to an observer irrespective of whether he is in motion or at rest relative to the source of the light, but how are we to know that light travels at this speed.

As a matter of fact we do not know anything of the sort, the only thing that we apparently do know is, that the physical universe is incapable of registering and presenting for our observation the appearance of any velocity greater than this.

If this is the case, should the real or potential velocity of light be *more* that twice the apparent velocity, it would be impossible, as in the case of our shafts, for the universe to present to our observation any velocity of light less that 186,300 miles per second, unless the observer were himself moving with a greater velocity than this towards the source of the light, which is impossible.

As we have already agreed that no greater apparent velocity is possible, we should therefore conclude that the velocity of light is constant (relatively) at 186,300 miles per second

Thus we have a condition analogous to that of our motor shafts, and as before stated we can only deal with appearances and the reality must always be beyond our ken. Therefore one assumption as to the reality is just as valid as any other, provided that it checks up with the appearances. Apparently all we have to do in this case is to assume that light has a real or potential velocity of not less than 372,600 miles per second, but that the physical universe is incapable of presenting an appearance of, or responding to a greater relative velocity of 186,300 miles per second, which is in accordance with our observations.

Science from the Orient

One of our correspondents, Mr E. R. Jacobs, writes as follows

After combing the Sesquicentennial for a souvenir of a scientific nature, my wife and myself motored over to Atlantic City and found just what we were looking for in the "five and ten cent" store This was a box of assorted shells, quite a little concological collection in itself, for only a dime. Turning over the box, the words "made in Japan" told the whole story In faraway Japan where labor is cheap and shells are plentiful they make this pretty little seashore novelty from which much can be learned I will now read Dr Cockerell's article with new interest for we have the specimens without laboring for them, and a shell on a popular beach is a *rara avis* It is only fair to say that collections of this kind can only be bought at seaside resorts and not in the ordinary "five and ten cent" stores of the city

A New Telescope Society

The interest in amateur telescope making is mounting by leaps and bounds So far, we have traced more than 1,500 who have taken up this engrossing work. The cooler weather of fall and winter, driving people indoors where they can work on their telescopes, is now giving this nation wide—and, in fact, world-wide—movement a stronger impetus than before. Recently an amateur in Los Angeles requested the names and addresses of those in his community who had purchased "Amateur Telescope Making." We supplied them, and a club has been projected. In several cases we have received requests from isolated amateurs in other communities, for the addresses of neighboring telescope enthusiasts. At the risk of causing occasional annoyance we have given these names to bona fide "T N's." Here is a letter from Los Angeles:

Editor, Scientific American:

For some time a number of amateur telescope makers have been planning to organize a society here in Los Angeles. Your "challenge" expedited matters somewhat, and the preliminary arrangements having been made, we are requesting you to do your "bit"

It would help us a great deal, since you are the only periodical common to all the 50 amateurs in Los Angeles, if you would give a little space in the Scientific American, telling of our meeting place and time

Here is the data

Meeting place Study room above Science room in New Public Library

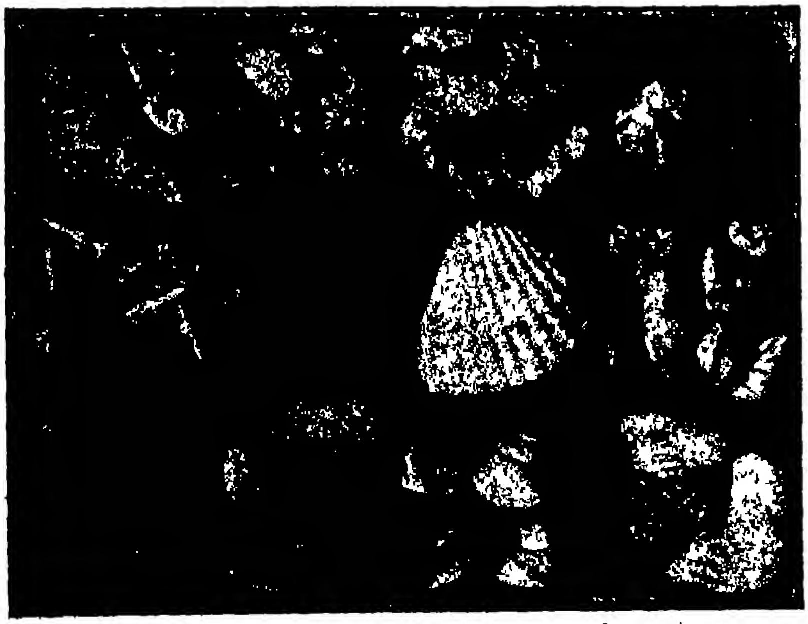
Time First Thursday in every month, at 8 P M, starting November 4, 1926

Everyone is welcome although we are making a special appeal to those interested in building their own telescopes.

After the telescopes still in the process of being built are finished, the society will doubtless promote useful work in astronomy

If you will give this to the public through your columns, you will be doing a great favor to the amateur astronomers in Los Angeles.

Very sincerely yours,
Charlton F Chute,
Los Angeles, California.



This interesting collection of shells cost one of our readers the small sum of ten cents. It is well worth the attention of the student of natural history

Commercial Property News

A Department of Facts and Notes of Interest to Patentees and Owners of Trademark Rights

Conducted by Milton Wright

Don'ts for Inventors

MANY inventors are afraid that someone is going to steal their ideas. They may be justified in this belief. Therefore it is unwise for any inventor to make his plans public before he has applied for his patent. You may devote years to perfecting some method or device and if you let it become generally known someone else may adopt it. Whether that other man succeeds in getting a patent on it or whether he uses the method or device without a patent it will make it harder for you to get patent rights and obtain the just reward to which your ability and industry are entitled. *Don't make a public disclosure of your invention until the application is filed in the Patent Office.*

There is such a thing on the other hand as carrying secrecy too far. It often happens that more than one person conceives the same idea at about the same time. Some time ago for example more than fifty different inventors applied for patents on the same invention—a stabilizer for airplanes—at about the same time. None could by any possibility have known of the activities of the others. It just happened that all these inventors hit upon the same thing. Priority of invention had to be proven. This could be done only by evidence of persons to whom the inventor had described his invention. *Don't fail then to tell two persons in confidence what your invention is and how it works. Put in writing the facts that you have told them and get them to sign and date the statement.* Then keep this statement in a safe place so that if a question should arise at any time as to whether you are the first to conceive the idea you will have the evidence to prove when you first disclosed it.

Why Patents Are Delayed

IN an oral statement on the changes effected in the Patent Office since his administration began five years ago Commissioner Robertson said recently:

"Our chief delay in granting patents comes through the inadequacy of our examiners. We have 600 of them and they are exceedingly skilled men. Most of them have college degrees. They must be qualified to examine applications for patents in every field imaginable and to decide not only whether or not the application infringes upon some previously granted patent but also whether or not the application is described in sufficient clearness to make it understandable.

Our chief trouble is that after an examiner has become expert and valuable to us we lose him to private industry. We lost 106 last year and during the month of August we lost 16. Although Congress has recently increased the salaries of examiners they are still taken away from us by the higher salaries of industry. Naturally when our staff of examiners is depleted we cannot pass upon patent applications as quickly as we should."

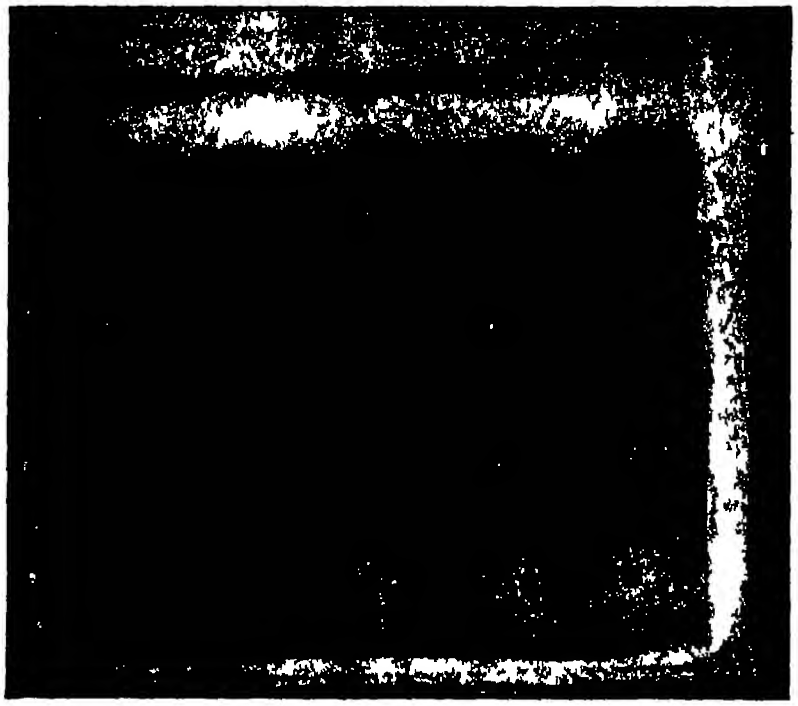
Golf Ball Meshes

FIRST Assistant Patent Commissioner Kinnan denies the application of the Dunlop Tire and Rubber Corporation to register as a trademark a particular form of the meshed surface of a golf ball.

"It is well known and not disputed here" he says "that the purpose of the meshed surface is mechanical to cooperate with the roughened surface of the club and possibly to aid in the reflection of light so the ball is more readily seen from a distance when it lies on the ground after having been driven by a player."

After citing certain decisions he concludes: "These decisions and those recited in them are persuasive that the meshed surface covering the entire ball and forming an integral part of the latter and performing mechanical functions in the use of the ball cannot be regarded as a trademark for the goods. To hold otherwise would in effect be granting a perpetual patent for a golf ball having these features of construction.

The purpose of a trademark is to denote origin. On this theory the Fisk Rubber Company last year registered their '06 tread design of automobile tire as a trademark. The Patent Office held that it is by the tread design that the make of tire is registered. The practice however was overruled by the Court of Appeals of the District of Columbia when the Goodyear Tire and Rubber Company sought to register its tire tread design.



Golfers can identify the make of a ball by its markings. Can you? The real purpose of the mesh markings, however, are mechanical, the Assistant Patent Commissioner holds, but he fails to mention the most important function of all—that of making the ball fly true

Delays Are Dangerous

HOW a first inventor may be denied a patent in favor of a later inventor is illustrated in the recent decision by the Patent Commissioner in the case of Parks versus Hoffman. The invention relates to operating shafts for low-speed clutch bands of Ford automobiles and is designed to facilitate removal of the shaft when the clutch or transmission band is to be removed for repair.

In deciding for Hoffman the Commissioner says:

"Parks testified that the device was taken from the shop car and that it was never again used; that it was placed in a pigeon hole of the office desk until about the time he filed his application for the invention admittedly being spurred on to do so by Hoffman's activities. Hoffman and the Hoffman Manufacturing Company gave the invention to the world several months before Parks filed his application. Parks' conduct taken with the testimony clearly shows that he never contemplated doing anything with the invention that it was kept secret and it remained a secret to the whole world except the interested parties Parks, Bohne and Simpson until after it was given to the public by another. These facts it is believed justify a holding of abandonment on the part of Parks."

A Real Pioneer Invention

JUDGE TUTTLE of the United States Court for the Eastern District of Michigan has written one of the clearest expositions of the distinction between mechanical skill and invention we have yet seen. It is in the recent decision establishing the right of George C. Walker and Thomas M. Lucking to collect damages for infringement from the Lakewood Engineering Company.

The Walker device, patent number 1,234,984, is used in finishing the surface of a road before the cement has set. Of its merit Judge Tuttle says:

"Nothing had been discovered that would do a better job than the trowel until Walker produced the patented invention in suit and brought in use the flexible belt or strap to be dragged across the surface of the road. It had never been used by any one so far as this record shows; no one had ever thought of such a thing or heard of such a thing as a flexible strap or belt to drag back and forth in a reciprocating movement across the surface of the road as the very last step in the finishing of the road.

Now this patent goes away beyond what can be called the work of a skilled mechanic. We have had a lot of skillful mechanics building roads and we have had a lot of engineers—and skillful engineers—building roads and we were fussing around with labor to do the last work by hand, and by hand I mean the trowel finishing of the surface and using other things that did not leave the work in as good shape as this simple device of the patent in the suit. It is simple as one thinks of it but that is just what defines an invention in my judgment.

"It is not these great complex machines that necessarily disclose patentability and ingenuity. The draftsman familiar with the strength of material—and mechanics—can build very large machines and put a lot of mechanical elements and movements into them making them expensive, but what we really intend by the patent law is to reward by the grant of a monopoly the bringing forth of something that can be used to our advantage which had not been thought of before. It makes the world a better place in which to live, as the result of what they have done. Here is a thing simple not difficult to make, but nobody thought about it, they had not done it before."

Walker's device was intended to be used by hand. The defendant uses machinery to accomplish the same result. This the Judge holds, does not avoid infringement.

"There is nothing," he says "that the defendant's belt does that was not done by the hand belt. Defendant's belt on the machine does not do so much because it is not necessary to do so much and of course not being necessary to do so much it is not necessary to make it so heavy.

They naturally change the tool to fit the work. That is the work of a skilled mechanic. No one has pointed out anything done by this belt of the defendants that was not done by the patent in suit. Defendants use this belt of the patent in suit and they get results from it or they would not use it, and those results are results accomplished by the patent in suit and this is infringement. Defendants do not need all the things that the plaintiffs' belt was designed to do and would do and they do not build it so that it would do all the things simply because they do not need all the things. That does not escape infringement. If a person has a patent to do certain things and accomplish certain results and if I do not need to accomplish those results fully but only partially and I take their machine to accomplish a part of the results I infringe."

How Valid Is a Patent?

"A PATENT is no good until it has been passed upon by the courts" is a statement sometimes loosely made. But just how true is it? Here is what the court has to say on the subject:

"The presumption that a patented combination is new and useful, and embodies invention has added force where as here it appears that the patents relied upon as showing anticipation were considered by expert patent office officials. While their judgment is not absolutely binding on a court it is entitled to great weight and is to be overcome only by clear proof that they were mistaken and that the combination lacks patentable novelty."

With these words Judge Gilbert writing the opinion for the Circuit Court of Appeals for the 9th Circuit denies the appeal of A. J. Moehr and Son and the Standard Oil Company to set aside the lower court's decision sustaining the validity of the patent of the Hopkins air brush for spraying paint owned by the Alliance Securities Company.

The User Helps to Infringe

HOW the user of a manufactured article can help to make that article infringe a patent is shown in the interesting decision obtained by D. Allen Leak over Hunt Lasher Company in the United States District Court in Massachusetts. The patent in question was for an automatic blow torch with a heat-conducting wire in a jet-tube and a plug wick in the flame cylinder, such as is used by jewelers, electricians and others for soldering and brazing.

"Defendant's jet-tube does not extend below the top of the blast cylinder and, as

originally sold by the manufacturer, no heat-conducting wire is inserted in the tube," says Judge Brewster. "But each torch sold is accompanied by printed instructions to users 'to insert two ordinary pipe cleaners in the tube' in place of the wireless wick, when that wick becomes charred. In these pipe cleaners is a metal center which, while not as efficacious as the copper wire used by the plaintiff, nevertheless embodies the same principle and when used clearly infringes claim six of the patent"

On these facts, the judge holds, the patentee is entitled to invoke two well established principles of patent law—the doctrine of equivalents and the doctrine of contributory infringement.

A Million-dollar Patent

"THE plaintiff has received nearly a million dollars in royalties from a dozen concerns, a tidy sum to receive for nothing" Thus Federal District Judge Bodine in New Jersey characterizes ironically the defense of lack of invention in the infringement suit of DeLaski and Thropp Circular Woven Tire Company versus Murray Rubber Company.

The Thropp patent, which contains 148 claims, provides for a machine for forming tire fabric down on the sides of the core and also forming it around and along the bottom of the bead The latter operation had been performed by hand or by separate devices.

"Some question was raised upon the argument that the devices involved mere mechanical skill," says Judge Bodine "A study of the inventions shows that more was involved The stitcher mechanism with the angle-changing device may be a very small matter, but it changed the tire building business from machining and hand construction to machine construction The defendant gives the tribute of its imitation to the invention.

"The whole tire is machine built, the underlying mechanism operates all parts of the machine and different elements operate upon the raw materials to produce the ultimate product. Thropp invented the machine, which is a true combination and not an aggregation. The plaintiff may have an accounting."

The Limits of Reissues

THE importance of drawing up the specifications and claims of a patent with the utmost care is illustrated in the infringement case brought by the Traitel Marble Company against U T Hungerford Brass and Copper Company The patent was that issued to S. H Calkins for improvements in pattern and guide strips. The defendants denied infringement, pointing out that the original Calkins patent had been reissued after having been declared invalid, and asserted that the reissue was invalid on the ground that a reissue does not and cannot confer validity

"The reissue patent number 15,824 can not broaden or add something that was not included in the original patent" Judge Goddard holds. "Section 4916—United States Revised Statutes which permits reissues, allows a patentee to limit the claims of the patent or to correct any defect or error which occurred from inadvertence, accident or mistake, but does not permit the injection of new subject matter into the patent Therefore, if the original patent was invalid for the lack of the disclosure of invention, it follows that reissue patents would continue to be invalid"

Post-mark Advertising

THE British Government Economy Act passed by Parliament enables British commercial firms to advertise their goods by means of post-office cancellation stamps. Heretofore these stamps have been used exclusively for official slogans, such as "Visit Wembley" or "British Goods are Best" Now the post-office department has given a contract to a firm of London advertising contractors for the letting of this privilege.

Patents Recently Issued

Pertaining to Aeronautics

AIRCRAFT FRAMEWORK MEMBER.—Formed of light metallic strips corrugated longitudinally to strengthen the same against crushing and expansion, the strip edges offering mating lap joints. Patent 1588327 D J Mooney, c/o Steel Wing Co, Nightingale Grove, Hither Green, London S E. 13, England

AIRPLANE CONSTRUCTION —Having an extended lifting surface composed of a plurality of longitudinally disposed spaced wires adapted to support a plurality of sections of thin metal strips. Patent 1598118. T Borgan, 111 Pioneer St., Brooklyn, N Y.

AIRSHIP.—In which means is provided for maintaining the ship in a set course and for generally stabilizing the ship during its travel Patent 1599400. W Sheppard, 21 Bethune St., New York, N Y

Pertaining to Apparel

SPORTSMAN'S WADING STOCKING.—Whereby the heavy rubber boots may be dispensed with, and a specially constructed elastic rubber stocking, having considerable freedom, at necessary points used Patent 1594080. C F Arnold, 230 California St., San Francisco, Calif

COMBINED STOCKING AND OVERSHOE.—Which combines the utility of an overshoe and a stocking in one article of neat and attractive appearance Patent 1590814 B R. Dodge, 1701 Coney Island Ave, Brooklyn, N Y

BATHING SUIT —Having the crotch of the trousers portion seamless, thereby increasing the wearing qualities, and comfort to the wearer Patent 1597033 H F Stephens, c/o West Coast Knitting Mills, Box K, Huntington Park, Calif

HOSE SUPPORTER.—Wherein the encircling band may be adjusted and is quickly engaged, but is locked when the parts are in operative position Patent 1597188 M F Gannt, P O Box 162, Dayton, Ohio

BOSOM-SHIRT CONSTRUCTION —In which the sides and lower edges of the bosom are free from the flexible body of the shirt, the bosom being secured only along a medial line Patent 1600880 C W Hutchinson, 15 E. 40th St., New York, N Y

SHIRT OR SIMILAR ARTICLE —Having a concealed adjusting means, including a series of fasteners, arranged to be effective in shortening the length of sleeves. Patent 1600807 M. Lesser, 570 Broadway, New York, N Y

SHIRT —Which permits of its being used as an ordinary detachable collar shirt but may be quickly converted into low neck or sport shirt. Patent 1599068. S Lipman 843 South Los Angeles St., Los Angeles, Calif.

ARCH BRACE.—Adapted to be incorporated in the shank of a shoe, to preserve the flexibility of shoe, and strengthen the arch at the inner side Patent 1601684 B E. Drake, 54 Lenox Road, Rockville Center, L I, N Y

Electrical Devices

RADIO TUNING DEVICE.—Including an outer primary coil, enclosing a secondary and tertiary coil, which triplex arrangement is placed over a standard bulb and socket. Patent 1598526. L. A Jenny, 128 E. Madison Ave, Dumont, N J

PORTABLE LAMP —Whereby means are provided for supporting the lamp without using nails, screws, or other securing devices, a combination vacuum and magnetic means being used Patent 1598559 G Cohen, 201 W 40th St., New York, N Y.

ELECTROMEDICAL APPARATUS — For the production of low frequency currents for application to the human body, easily regulated to produce a variety of effects. Patent 1598902. K P Hangl, 1138 Tinton Ave., Bronx, N. Y.

SADIRON —Which comprises electrically heated heavy roller, mounted to allow rolling over the work instead of sliding in the conventional way Patent 1596181 L M Hills, 325 Georgia Ave., Santa Monica, Calif

ELECTRIC TRIMMING AND SEAM CUTTING MACHINE.—For cutting cork carpet, rubber flooring, battleship linoleum, and similar flooring material laid in sheet form. Patent 1598070 F J Fauso, 634 Seybold Bldg, Miami, Fla

ELECTRICALLY CONTROLLED VALVE.- For automatically controlling the flow of gas to a burner for drying paper, during all the time that the presses are in operation Patent 1600287 F E Lull, 2936 74th Ave, Elmwood Park, Chicago, Ill.

RADIORECEIVER.—Particularly adapted for installation in the conventional radio panel, allowing the electrode to be selectively engaged with and disengaged from the crystal Patent 1599471 R F Kenyon, 46 Caine Ave, San Francisco, Calif

Of Interest to Farmers

INCUBATOR. Including a tray removably supported, having a plurality of rollers for supporting the eggs and motion transmitting means for the rollers. Patent 1598681 C Y Hake c/o Green Hill Poultry Farm, R. F D No 3, York, Pa

SELF DISCHARGING CULTIVATOR.—Which will operate between rows of corn or the like, scooping stones, weeds, etc., to the center space and automatically dumping them out of the way Patent 1598900 L A De La Nux and A P Canova 1125 So King St., Honolulu, Territory of Hawaii

DUST GUN —A small manually operated device, with double action thus insuring a constant supply of air pressure for distributing an insecticide on growing crops. Patent 1600861 C G Allgrunn, c/o A S McDaniel, 434 W 120th St, New York, N Y

Of General Interest

FOLDING TABLE.—Having novel and efficient means for holding the legs releasably either in folded or top supporting position Patent 1593975 C F Karstens c/o Fond du Lac Table Mfg Co, Fond du Lac, Wis.

RUBBER STOCK RACK —Which will receive the hot rubber stock directly from the mill and will properly support the same without the use of soapstone Patent 1597631 F Spindel, Morrisville, Pa

AMPLIFIER.—Constructed to accommodate any standard type of loud speaker unit, and will function to evenly distribute the sound in all directions Patent 1597611 B Mazanick 400 E 75th St, New York, N Y

SAFETY GAS COCK -For use on the ordinary type of gas cocks, the cock being protected from accidental turning by spring pressed latches Patent 1596913 J G Wilson Ellendale, Del

INKWELL.—Including a pen stand with ink well and enclosed fountain, for supplying said well with a relatively small quantity of ink Patent 1596920 F H Casey Box 172, Gardner, Mass

ROADBED CONSTRUCTION —By the arrangement of hexagonally formed slabs in such manner that a single slab will stand a maximum of pressure Patent 1595086. L A Perry, Longview, Wash

BUTTER DISPENSER.—In which the butter may remain in relatively large pieces, means being provided for severing a portion of predetermined size and weight. Patent 1597149 Irene G Johnson and P O Berg c/o Mrs I G Johnson, 630 W. 141st St, New York, N Y

SANITARY COLLAPSIBLE INSECT TRAP —In which the fly paper is entirely concealed and held in a flat plane, a number of openings providing access for the flies. Patent 1597,-287 E. E. Pinkerton, c/o Pinkerton Folding Box Co., 414 Rush St., Chicago, Ill.

The contractors have received a schedule showing the number of stamping machines at every post office and the average number of letters a week passed through them, so that advertisers know precisely what advertising opportunities are available Hereafter, therefore you will know what it is all about should you receive a letter from London postmarked "Good morning Have you used Pears' soap?"

Switch Patents Upheld

THE District Court of Western New York, in the case of the Electrical Engineers Equipment Company against the Champion Switch Company holds the disconnecting electrical-switch patents for high voltage circuits, valid and infringed

The object of Getts was to make a switch structure of the so-called disconnecting type, in which a maximum of contact was obtained between the fixed lugs and the switch blade or blades, while Jacobs designed, (1), an improvement in the spring pressure of the blades, and (2) a novel form of lock mechanism The utility of the patented structure is shown by the fact that it has largely supplanted other high voltage switches due to overcoming objections in the prior devices.

Judge Hazel holds

In view of the advance made in the art by both Getts and Jacobs, the claims for the broad invention do not require a narrow construction, and plaintiff is entitled to a fair range of equivalents. It is unnecessary to analyze the numerous claims of the Jacobs patent Each contains a feature of novelty in relation to the invention, and all are found in defendant's structure

"A decree may be entered with costs, holding the Getts patent and the Jacobs patent valid and the claims infringed by the structure of the defendant"

You Get Only What You Ask For

THE old saying that an inventor gets no more protection than he asks for in his patent claims is illustrated clearly in the recent decision of United States District Judge Tuttle in the Eastern Michigan District dismissing the suit for infringement brought by the Great Western Manufacturing Company against the Lowe Manufacturing Company The patent in question was for a gyrating sifter One of its features is portability Judge Tuttle says

"While I am convinced that a claim covering this idea could have been drawn and would have been novel this idea is not expressed in the claims in suit, and cannot be read into them It is possible that the inventor regarded his construction as entirely novel and therefore, after preparing the broad claims in suit, he neglected to embody portability in any of his claims.

"Plaintiff's suggestion, that the court read into this claim certain limitations so as to save the claim from being anticipated, cannot be accepted

"We must take this patent as it was prepared Combs did not write such limitations into any of his claims and we do not know why he did not do so

"If an inventor were permitted to obtain broad claims and thereafter write in such limitations as are necessary to avoid the prior art but still cover an alleged infringing structure, the public would never be certain as to the meaning of a claim and endless confusion and litigation would result."

Italy Falls Into Line

TECHNICAL men will welcome the news that Italy, following the example of the other leading countries of the world has commenced the printing *in extenso* and in separate numbers of the specifications of patented inventions. All patents granted after October 1 of last year are said to come under the new regulation.

This leaves only Belgium Spain and Portugal among the leading European countries still to take this important step in the right direction

CLOTHES PROTECTOR FOR IRONING BOARDS Attachable to the standard or support of an ironing board forming a guard upon which or changing pieces of clothing may be held Patent 1596940 A G Noisworthy 806 Palm St St Jacksonville Fla

BUILDING CONSTRUCTION —By an arrangement of precast slabs which may be finished so as to constitute a complete part of the building when erected Patent 1597167 I D Pace Alexandria La

ACCOUNTING CALENDAR.—A monthly sheet for calculations through the use of which accounts of such commodities as milk bread and ice may be easily kept Patent 1597280 I G Mu hauer 2016 Palmer Ave New Orleans La

CHAIR —Capable of a number of uses, the construction being such that it is easily convertible into a step ladder or a high-chair Patent 1596909 F H Weeks 701 E Market St, Akron, Ohio

COMBINED DUSTPAN AND HOLDER FOR BROOMS ETC —Which may be readily manipulated for a desired purpose or may be hung up for supporting brooms brushes and the like Patent 1598168 E E Stosser c/o Y M C A, 5 83rd St New York N Y

TRACK CURTAIN HOLDER — Providing means for facilitating the suspension of a curtain or the like and for permitting the same to be readily moved Patent 1598479 C P Day and A Watts c/o H L Judd Co, 87 Chambers St New York, N Y

ORNAMENTAL CANDLE —Of the wax body type, with means for preventing the candle from becoming deformed in the presence of abnormal heat. Patent 1598454 M R Sidwell, 423 Arch St, Camden, N J

BATHING CHAIR —In which a bather may assume a comfortable seated position in the water without danger of tipping over and submerging the head Patent 1598457 J Sommer, 842 Rebecca Place, Elizabeth N. J

CARBOY —Having at its sides and bottom resilient members to which are secured retainers carrying replaceable buffers Patent 1598534 C Lefkowitz, c/o Hercules Carboy Co, 850 South St, Newark N J

HOT PAN LIFTER AND REMOVER —By which an operator may safely manipulate a hot pie pan without danger of being burned or spilling the contents of the pan Patent 1598536 J A List, Carlyle Ill

DENTIPHONE —For use with talking machines in order to reproduce the records in such a manner that deaf persons may enjoy the same Patent 1598575 J W Gouce Anderson Tenn

COMBINED TABLE AND BOOKREST —Adapted particularly for use in a sick room although not confined to such use the device may be readily adjusted Patent 1598560 C G Fitzhugh The Maples, 713 19th St. N W, Washington D C

MOLD —Especially adapted for use in the production of the packing rubbers employed on swabs and other well equipment Patent 1597761 L G Burt 325 E 4th St, Tulsa Okla

REMINDER.—For household use to indicate the condition of supplies of various commodities as they require replenishing Patent 1598822 D I Showalter Frankfort, Ky

BRUSH OR MOP HOLDER —Which is interchangeable permitting of a different frame being readily attached whereby the mops or brushes may be varied Patent 1598549 H Berlow, 156 E 171st St New York N Y

PEN CLEANER.—Wherein means are provided for wiping an ink clot from the end of a pen and also polishing the pen Patent 1599118 T A Chrysander, 201 W 109th St New York N Y

COOKING ACCESSORY —Affording means for supporting solid food stuffs above the bottom of a cooking utensil and precluding burning in the event of the liquid boiling away Patent 1599321 I S Devlin, 1445 University Ave New York N Y

DISCHARGE TUBE AND CONNECTION — Capable of use in conjunction with an outlet for conducting waste material the device may be readily detached and reattached Patent 1599131 R Kuraban 13 Lexington Ave Brooklyn, N Y

FLOWER HOLDER —For bowls and the like wherein a plurality of rods are provided for holding the flower stems in a desired position Patent 1599320 W S Daniels 161 Davis Ave, White Plains N Y

CONNECTING DEVICE —For adjustably connecting together two ends of a flexible element such as a rope, clothesline or the like Patent 1599342 H J Muhlfeld, 249 8th Ave, Astoria, L I, N Y

TYPEWRITER DESK —In which ample knee space and leg room is provided under the desk when the typewriter supporting platform is lowered Patent 1599351 F S Fettsel, 68 Dover St. Albany N Y

BILL FOLD —In which the clamping means provides convenience in inserting or releasing bills, and a transparent element is provided for an identification card Patent 1599392 E Seavey, 359 Pearl St, New York, N Y

GARMENT HANGER —Which is extensible or contractible, may be conveniently stowed in a suit case or even in the coat pocket Patent 1598747 J F Scharles c/o C M Walker, 627 Davidson Bldg, Sioux City Iowa

HUMAN EXERCISER AND STRENGTH TESTER —Which may be utilized to exercise and develop the human body uniformly to a high degree thereby upbuilding the general strength and health Patent 1598940 S S Smith Steelville, Ill

ARTIFICIAL FISHING BAIT—In which means is provided for instantly changing the general color of the bait, by substituting shells of different tints Patent 1599763 D Head, 1320 Birchwood Ave, Chicago Ill

UMBRELLA HANDLE —Which is adjustable to constitute a straight handle for women or an angular handle as generally preferred by men Patent 1600046 S J Goldwin 1195 E 14th St Brooklyn, N. Y.

DISPLAY STAND —Which may not only be adjusted to different positions but may be used to support a number of different objects Patent 1599616 S Hamburger, 706 Ave C, Brooklyn, N Y

TREE REMOVER —By means of which the roots may be cut and the tree with its roots and part of the soil lifted bodily for easy transportation Patent 1599841 H A Sager 1601 No Van Buren St., Missoula Mont

ROLL —Shaped especially to form a receptacle or space for a frankfurter or other edible material in the form of a sandwich Patent 1600191 E Mandelbaum 53 Hamilton Terrace New York N Y

STENCILING DEVICE —Which includes a plurality of individual stencil elements and a frame for interchangeably assembling the same for use Patent 1600177 A Horowitz c/o Specialty Products Co, 545 West Chester Ave, New York N Y

PORTABLE SACRAMENTAL AND DEVOTIONAL ALTAR —Which may be readily erected in the home or hospital for private devotional purposes in administering the sacraments of baptism and communion Patent 1600107 C Gay c/o Gay Bros, 142 Rowe St, New Haven, Conn

BALLOON ADVERTISING METHOD AND APPARATUS —By which circulars novelties etc can be sent aloft over a public gathering and at an opportune moment be scattered over the people Patent 1598211 E J Maguire c/o H D Schroeder & Co 1616 Bush St, San Francisco, Calif

Hardware and Tools

SOCKET WRENCH —For tightening or loosening nuts of various sizes, such as those used on clamps for guy wires on telephone poles Patent 1597785 F J Grant, 5922 Ada St Chicago, Ill

ELEVATING TOOL —For lifting sucker rods as used in well drilling without the liability of disconnection or accidental release of the rod Patent 1599343 L Fielding 110 'B St, Oxnard, Calif

ANIMAL TRAP —Having an attachment for preventing the accumulation of matter under the swingable trigger without interfering with its downward movement Patent 1598780 B McCabe R F D No 6, Cresco Iowa

SAW —In which the blade is adjustable at an angle to the handle frame and may be readily locked in operative position Patent 1598905 R W Graves c/o Munn Anderson & Munn 24 W 40th St, New York N Y

FISHING TOOL —Especially adapted for use in wells having novel means for gripping a sucker rod at the shank, in cases where the box is broken off Patent 1598708 C H Brown c/o Brown Welding & Machine Co, Breckenridge, Texas

JEWELERS' TOOL —A single tool in which rollers of varying sizes may be employed according to the requirements of a given piece of work Patent 1600142 M Rothenberg and I Attias, 440 W 45th St., New York, N. Y.

SURVEYING INSTRUMENT —A binocular instrument of great precision and long range, no exposed or movable stadia hairs the hairs being within the instrument. Patent 1598519 A D Hadsel, 500 Cale Bldg, San Francisco, Calif

STOVEPIPE SUPPORT —Adapted for supporting the angularly disposed runs of a stovepipe against sagging, or accidental displacement from one another Patent 1598503 W L Plummer, 1131 "T" St., Sacramento, Calif

BULL HOOK —Having means therein adapted to automatically act to avoid danger of displacement of the engaged end of a choker line. Patent 1599727 S B Stewart, 220 So King St, Centralia, Wash

WINDOW FASTENER.—Which serves the double purpose of preventing rattling, and will permit of the sashes being slightly raised or lowered, and locked against further movement. Patent 1600850 J A Segalini 500 Graham Ave, Long Island City, N Y

THREAD-PROTECTING DEVICE —Easily slipped over the end of a pipe to protect the threads against damage by contact in the movement of the pipe Patent 1600660 C D Young, c/o New London Ship Engine Co, Groton, Conn

WRENCH —Particularly easy to operate, and having a positive stop for the sliding member requiring an actual release before it can be adjusted. Patent 1599202 M Brande, 146 Embarcadero, San Francisco, Calif

STOVEPIPE SECTIONS —Which has one end locked against expansion and the other end locked against contraction, the ends forming a threaded joint. Patent 1601640 J V Orr, Box 146, Monroe Wash

CARPENTERS' SCRIBING GAUGE.—Having an extensible body and protector heads for the scribing plates, for numerous uses such as cutting stair treads fittings shelves, etc. Patent 1601138 D Moore South Lancaster, Mass

ADJUSTABLE T SQUARE —The head and blade being pivotally connected a disc secured to one member and ring member to the other Patent 1599776 Z G Lazarevich 69 Joost Ave, San Francisco, Calif

HAMMER FOR PERCUSSIVE DRILLS —Arranged to permit tempering or hardening of the dolly head to any desired degree without injuring the tongues or rifles Patent 1601644 W S Pekovich c/o Admiralty Alaska Gold Mining Co Juneau, Alaska

BOLT FOR COMPOSITE FLOORS —For forming a connection between the concrete and the sleepers for a wooden floor and prevent ing surface irregularities. Patent 1599745 J M Cinnamond, 620 4th St, San Francisco Cal

COMBINATION LOCK —Capable of a large number of combinations and permitting of general use particularly as a substitute for inexpensive key locks Patent 1600388 J A Jones, 4235½ W 28th St, Los Angeles, Calif

KEY ACTUATED ROPE LOCK —Adapted to receive the two strands of a rope which close the opening of a mail bag preventing movement in a direction to open the bag Patent 1601046 R L Shannon, 501 Lyman Ave, Oak Park, Ill

RAZOR ATTACHMENT —Which is applicable to safety razors and will function to constitute a receptacle beneath the guard to catch the lather as it is removed Patent 1600686 J D Kaltenback and J Stoll, Hotel Cort, 34 Ellis St, San Francisco, Calif

ADJUSTABLE SOCKET WRENCH —Which is adjustable to be suited for a number of different sized nuts and constructed for the handling of nuts in inaccessible places Patent 1600645 J C Smith, Box 74, Milpitas, Calif

Heating and Lighting

HOT WATER HEATING SYSTEM —A combination tank heater and house heating boiler so arranged that either may be cut off, and the heat generated into the other Patent 1599323. A. H Frank, Columbia, Pa.

RADIATOR.—Wherein the water is heated by an electrical heating element without altering existing radiators, thereby eliminating the cellar furnace and boilers. Patent 1597014 A. B. Campbell and I. L. Brownwell, Orlando, Calif.

GAS BURNER.—For furnace or boiler structures, embodying a plurality of reversible and adjustable burner tubes whereby the heat generated may be effectively controlled. Patent 1600175 P C Hughes, 1516 E. 6th St., Tulsa, Okla

STOVE.—Wherein the feeding of the fuel to the grate and the removal of ashes may be accomplished without the escape of dust. Patent 1600110 C. Griffin, 16 E. Cross St., Ypsilanti, Mich.

GASLIGHTING DEVICE — Whereby whenever a gas cock is opened magnetic means are actuated to produce a spark for igniting the gas Patent 1600657 S J Woods, 10 Burdick Ave, Newport, R I

OIL BURNER. — Which has automatic means for controlling the flow of fuel, both to the valve and combustion pot, and protecting the pilot flame Patent 1601242. J. B Danis, 2400 Church St., Norfolk, Va.

INCINERATOR.—Adapted for holding refuse or waste material while being burned, the device is of durable construction, and the grate may be replaced Patent 1601657 J W Thompson, 15 Terrace Ave, White Plains, N Y

Machines and Mechanical Devices

PLASTIC MOLDING MACHINE.—Having a plurality of stationary molds capable of being readily expanded for the quick removal of molded articles without possible adhesion Patent 1598792 J F Caldwell, 212 Chamber of Commerce Bldg, Los Angeles Calif

WATER-WHEEL UNIT —Embodying a plurality of wheels each having blades automatically feathered under the action of the moving water to fully utilize the power Patent 1598804 F L McQuiston, 817 Garnet St., Redondo Beach, Calif

WAVE MOTOR.—Utilizing a continuous flow of water, and automatically adjusting itself to the flow of a river, or the change of tides, for producing power Patent 1594,426 L G Fairbank, 376 Ellis St, San Francisco, Calif

HOIST — A machine of the hand operated type having a maximum drum capacity the desirable range in speed and power, and is readily controlled Patent 1596477 R H Beebe 3223 1st Ave So, Seattle, Wash

DETACHABLE COUPLING —For pipe, hose and similar conduits especially easy to manipulate, permitting of quick attachment or detachment in practically one movement. Patent 1596645 E T Whatley, 1119 Duffy St, East, Savannah, Ga

FLEXIBLE COUPLING — Embodying two coupling members utilized upon the adjacent ends of alined shafts, connected by movable elements, secured through circumferential openings Patent 1596327 W S Weir and A P Foley 627 Ivy St, Pittsburgh Pa.

STOP MOTION FOR LOOMS —So constructed that when any of the harness wires break a proper connection will be made for causing the stop motion to function Patent 1597574 A W Boucher, 40 Luck St, Burlington, Vt.

CHAIN AND BUCKET EXCAVATOR.—Of the type employed in excavating land for the recovery of precious metals, the device having means for automatically scavengering the buckets. Patent 1595721 W P Hughes, 1157 Park Ave, Alameda, Calif

PRESS PAPER-ROLL CHUCK.—Which will operate automatically in holding the roll against rotation, so that it will not unravel or break during slack Patent 1597568. R W Bandy c/o Seattle Post Intelligence Seattle, Wash

STROBOSCOPIC APPARATUS —For studying the movement of mechanism moving at relatively high speed, and having a specially arranged flashing means driven synchronously with the moving body Patent 1597596 A J H Elverson, c/o Andrews & Beaumont, 204 Bank Chambers 29 Southampton Building, London, W C 2, England

EXPANSIVE AND CONTRACTIVE DEEP-WELL DRILL.—Having simple means whereby the cutters are automatically moved to their operative positions, when reaching the limit of their downward movement Patent 1597,143 O M Carter, 208 Scanlan Bldg, Houston, Texas.

SLICING MACHINE —In which the meat or other material to be sliced is repeatedly presented to a revolving disk knife Patent 1596569 W J. Drucker, 909 Main St, Evanston, Ill.

Roller Cutter.—Especially designed for use when rock or other hard substances are encountered, the drill being designed to sink the hole more rapidly. Patent 1597144. O M. Carter, 206 Scanlan Bldg, Houston, Texas.

Babbitting Jig.—Which is adjustable to properly support connecting rods, bronze backs and other forms of sectional bearings in proper position to be rebabbitted. Patent 1598540. H A Miller, 712 Mitchell St, Clovis, N M.

Moss Gathering Device.—By means of which tree moss may be effectively and easily gripped and torn loose, may be manipulated from the ground. Patent 1598514. J W Banner, Route 1, Oxford, Fla.

Hydraulic Lifting Device.—For elevating sand and other granular material from a given place to a location at a higher elevation. Patent 1598558. E Cohen, 224 W A St, Picher, Okla.

Fire Fighting Apparatus.—Whereby the advance of flames or smoke in any given direction can be opposed efficiently by means of an air blast. Patent 1598568. C B Fields, 104 Linden Ave, Brooklyn, N Y.

Skeining and Assembling Machine.—Which will form a skein from thread or yarn, will secure the ends of the thread together, apply a wrapper thereto, and discharge the finished skein. Patent 1598908. C A. Hammond Knowlton, c/o Belding Hemingway Co, 232 Madison Ave, New York, N Y.

Bottle Capping Machine.—For capping a form of non refillable bottle and subjecting the cap to pressure to conform to the *beaded neck of the bottle*. Patent 1599325. J J Garibaldi, 43 Macdougal St., New York, N Y.

Shuttle Spindle.—Wherein the spindle functions to continually present an expanding and contracting member, whereby the cop of the core is gripped. Patent 1599291. J Schumacher c/o Schwarzenbach Huber Co, Union City N J.

Cotton Picker.—Having rotating picking fingers imparting alternate fast and slow movements at each revolution, during their passage through the plants. Patent 1599813. H N Berry c/o H A Gamble, 212 Main St., Greenville Miss.

Candy Vender.—Which is extremely simple, takes little space, presents the candy in an attractive manner in measured quantities, and in small bags. Patent 1596980. G H Koster, 44 Glen Ave, Oakland Calif.

Dishwashing Machine.—Adapted to be set in a sink board, discharges its water into the sink, and is run by a motor. Patent 1596060. P Hedstrom, 194 E 31st St., Portland, Ore.

Belt Driven Packer.—Having an attachment which will cause the tamper head to automatically descend when the press box is full of cotton. Patent 1599012. W H Holtby, c/o Holtby Packer Co, Chickasha, Okla.

Molding Machine.—Having means for automatically elevating the molded articles to free them from adhesion to the mold bottom and sides for easy removal. Patent 1599673. J F Caldwell, 212 Chamber of Commerce Bldg, Los Angeles, Calif.

Dispensing Machine.—In which the feed of the material from hopper to delivery device is very simple, and the cost of manufacture low. Patent 1600886. J E Kenkel, 808 Central Ave, Great Falls, Mont.

Automatic Bailer.—For boats which is durable in use, may be readily taken apart and cleaned if it becomes clogged. Patent 1600949. A. H Schweitzer, Valley St. and 5th Ave, Highlands, N J.

Mold Handling Apparatus.—Entirely automatic in its completion of a cycle of operations, designed for use in conjunction with any type of brick molding machine. Patent reissue 16424. E D Cary, 434 W 120th St., New York, N Y.

Automatic Drink Mixer.—With means for starting, regulating, and timing the agitator, and stopping the motor when the mixing has been completed. Patent 1600548. J A. Heard, 217 Delmar, San Antonio, Texas.

Signal-Operating Mechanism for Gasoline Tanks.—Controlled by the level of the fluid for operating a signal when the level has fallen to a predetermined point. Patent 1600695. S. Kanter, c/o William Frank & Co., 129 Carondelet St., New Orleans, La.

Printing-Press Roller.—Made in sectional form, so that when the central section becomes worn, it may be readily replaced without discarding the entire roller. Patent 1600841. J G Neall, 90 Pleasant Ave, Pleasantville, N Y.

Beam Head Brake for Looms.—Producing a uniform tensioning means which is comparatively simple, and by which wear on the beam head rope is reduced to a minimum. Patent 1600028. J Carroll, 61 Henderson St, Paterson, N J.

Automatic Tabulator.—For monotype composing machines adapted to allow of effecting compositions divided in columns by ensuring the automatic justification in each column. Patent 1600838. E Garda c/o C Chassevent, 11 Boulevard de Magenta Paris, France.

Container for Vending Machines.—A metallic container to be used in lieu of glass and readily adapted to different makes of machines for vending peanuts, candy, etc. Patent 1601617. D Greene, 1358 41st St. Brooklyn, N Y.

Grain Circulator.—A simple and effective apparatus readily attachable to storage chambers of various characters whereby granular material may be circulated and aerated to prevent overheating. Patent 1601224. J F Reavis, Baguio Benguet, Mountain Prov, Philippine Islands.

Medical and Surgical Devices

Hypodermic Device.—Particularly adapted for obtaining perfect sanitary conditions, a single use of the device making a second use impossible. Patent 1594595. E Brauer, 9 Wegman Parkway, Jersey City N J.

Colonic Irrigating Device.—Which will afford the maximum dimension of outlet without presenting barriers to the flow of fluid readily introduced into operative position. Patent 1596847. J S Mallory, c/o General Delivery, Asheville, N C.

Adjustable Plane Articulator.—Adapted for dentists by which the actual centers or axes of rotation can be readily ascertained and fixed for each individual head. Patent 1598535. J A Lentz, 44 No First St, Phoenix Arizona.

Musical Devices

Piano Action.—Which aims to insure greater rhythmic precision a quick repetition of the hammer strokes and a reduction in number of parts. Patent 1598203. B F Laukandt, 1234 W 6th St Red Wing Minn.

Pipe-Organ Control.—Which consists largely of relay and chest actions which cooperate in such a manner as to practically constitute one part. Patent 1599178. G H Kloehs, 121 No 18th St, Philadelphia Pa.

Piano Action.—For upright pianos, designed to take up little room thereby obviating the necessity of extending the piano casing to accommodate mechanical players. Patent 1599743. J W Carnes, 101 W Central St, Kewanee, Ill.

Prime Movers and Their Accessories

Spark Gap Apparatus.—Adjusted to permit the passage of the first discharge, but too wide to be bridged by the return and subsequent pulsations from any single discharge. Patent 1594457. P Davey, c/o Andrews & Beaumont, 204 Bank Chambers, 29 Southampton Bldg, London, W C 2, England.

Air Circulator for Internal-Combustion Engines.—For venting and circulating the air in a transmission case permitting the escape of hot air and the entrance of cool air. Patent 1595020. O H Nadler, 1205 N 13th St. St. Joseph, Mo.

Charge Hydrator.—Which will be automatic in its action to feed aqueous moisture to the charge, and will provide for complete control of operation. Patent 1595704. S B Caldwell, 7030 Lacy Way, Oakland, Calif.

Internal Combustion Motor.—Making use of a single rotary intake valve, and a rotary exhaust valve for all the cylinders a novel gear mechanism operating the valves. Patent 1596069. F C Skiles, 653 N Central Ave, Chicago, Ill.

Steam Generator.—In which the heat both in downward and upward flow is utilized, the rising heat being used to assist in vaporizing incoming raw fuel. Patent 1596797. C T Briar, 1211 Arnold Place, San Diego, Calif.

Crank Pin Lubricator.—For lubricating bearings in instances where devices such as dippers do not form part of the general equipment of the motor. Patent 1595131. B H Wilder Orleans, Calif.

Carburetor.—Having a primary and secondary air supply and fuel supply controlled by the same suction operated mechanism and a manual control. Patent 1600294. M B Nice, 5000 Cottage St Frankford Pa.

Packing for Rotary Engine Pistons.—For effectively preventing the passage of steam past the moving part of a piston thereby preventing loss of power. Patent 1601 97. S F Kochendarfer 911 "L" St N W, Washington D C.

Railways and Their Accessories

Railroad Crossing Signal and Process of Operating the Same.—Which is illuminated by the headlight of an approaching locomotive whereby a person approaching the crossing will know that a train is approaching. Patent 1591443. K M Bard Manawa Wis.

Pullman Berth Guard.—Adapted to extend across the front of a berth to prevent persons in the aisle being thrown into the berth by a sudden lurch. Patent 1599099. L. Hartwell 3139 Indiana Ave Chicago Ill.

Automatic Railway Gate.—Actuated by a passing train not only operating the safety crossing gate but a series of visual signals connected therewith. Patent 1599311. W H Finney 918 Grove Ave Nashville Tenn.

Freight Car Door.—With automatic means for securing the same in either open or closed position equally adaptable for single or double doors. Patent 1597079. E W G Kugley Box 583 Charleston S C.

Wrist Pin for Locomotive Crossheads.—Which may be driven in place from the outside and removed with facility, the loosening while in operation being a remote possibility. Patent 1599740. H G Becker Colonie P O Watervliet, N Y.

Air Control for Locomotive Fire Boxes.—Causing a higher degree of superheat and less back pressure and protecting the fireman from the excessive heat of the fire box. Patent 1600280. J N Glover c/o Robertson Higgins & Boddington, 428 Brotherhood Bldg Kansas City Kansas.

Pertaining to Recreation

Toboggan Slide.—For directing a toboggan formed of a plurality of boards so secured that they will be practically equivalent to a single board. Patent 1594444. J W Bernardy Beardsley Minn.

Amusement Device.—Having a rotary carrier with seats for passengers the carrier being propelled either by the passengers or any other driving means. Patent 1599014. O B Hunter, 1126 So 6th St. Chickasha Okla.

Pertaining to Vehicles

Vehicle.—The inventor has been granted two patents on spring suspension for road and rail bogie vehicles requiring no alteration of compression of main springs on tilt of bogie and permitting steering with but little effort. Patents 1405448 and 1517193. Montague Churchill Shann 548 Hanel St, Albury Australia.

Luggage Carrier and Tourist Table.—Adapted to be connected to the running board of an automobile may be employed as a table by day or a bed at night. Patent 1597081. C R Lyon, 1317 A St., Butte, Mont.

Multiple Valve Grinder.—By means of which the entire set of valves of a motor may be simultaneously ground in one operation. Patent 1597601. J J Kilbride Mountain and Montague Aves, Scotch Plains N J.

Gear Shifter.—Almost solely actuated by the exhaust gas of the motor a brief use of electricity and the pressure of a push button and the clutch pedal. Patent 1597253. W G Stevens, Jr 100 W 55th St New York N Y.

Tire Carrier and Changer.—Which functions either as a carrier for a spare tire or as a tire changing means to be emplaced on a table or support. Patent 1599427. J T Greenwood, North East Harbor Nova Scotia Canada.

Trailer Hitch.—Which affords facilities for connecting a trailer with the frame of an automobile truck so that the pole can swing without transmitting motion to the vehicle. Patent 1599634. W O Nabors, c/o Nabors Garage Mansfield, La.

Detecting Device.—For detecting an automobile driver who hits a person with his car and drives on, the device is intended to be under police control. Patent 1598685. B R Edwards, 2439 Grove St Berkeley Calif.

Vehicle Stop Mechanism.—A mechanism operable to block the road wheels of a vehicle and prevent translatory movement of the running gear in one direction. Patent 1600111. W A Haegele, 662 Court St Elizabeth N J.

Deflector for Headlights.—That will brilliantly illuminate the runway from a point far in advance but will prevent glare. Patent 1600271. A J Bishop Box 441, Lincoln Ill.

Automobile Awning.—Which is inconspicuous when not in use but can be instantly lowered to serve as a sun shield or to prevent rain entering a window. Patent 1600270. J W Barnes 32 Mills St Park Ridge Ill.

Signal Device for Motor Vehicles.—Especially adapted for trucks or busses to be swung into operative position and become automatically illuminated to indicate the direction of turn. Patent 1600273. J I Glancy 481 W 25th St Chicago Ill.

Corner Glareshield.—Which will simultaneously shield both the front and side vision of a driver against the glare of the setting or rising sun. Patent 1599183. G I Phillips Box 474 Imola Calif.

Fire Tube Boiler.—For use in connection with motor vehicles increasing the power because of the resistance to condensation by the high temperature within the cylinder. Patent 1599109. P C Dykes c/o B W Luke Mercantile Trust Co Front and Clay Sts San Francisco, Calif.

Pedal with Double Pivot Joint.—For vehicle brakes so disposed that the reduction ratio will be small during the period corresponding to the taking up of the wear. Patent 1601040. C Schaeffer c/o C Bletry, 2 Boulevard de Strasbourg Paris, France.

Child's Vehicle.—Comprising a frame, front and rear wheels gear trains and pedals adapted to be propelled by the feet of a child. Patent 1600646. J Stetson c/o Nelson Steamship Co Pier 24, San Francisco Calif.

Engine Hood Locking Device.—For automobiles wherein the hood will be normally locked but may be manually unlocked when the engine is running. Patent 1598572. J P Geraghty 481 Grove St, Jersey City, N J.

Short Circuiting Device.—Adapted for electric motors for short circuiting the commutator of the motor in order to prevent overloading the same. Patent 1600124. S F Miller 2229 Hobbes Ave Springfield, Ohio.

Designs

Design for Curtain Pole Brackets, Pole Ends and Pole Center Ornaments.—H L Judd & Co 87 Chambers St New York City have been granted twenty-one patents relating to curtain pole brackets, curtain pole ends center ornaments for curtain poles and the like having characteristic designs produced by their designers A Dlouhy and W F Hofman. The patent numbers are 70733 34 35 36 37 38, 39, 70740 41 42 43 44 45 46 47, 48 70755, 56 57 58 59.

Design for a Watch Band or Similar Article.—Patent 70872. H Bertolone, 17-19 W 45th St New York N Y.

Design for a Child's Dress.—Patent 70827. F Davis c/o Franklin Simon Co, 38th St and 5th Ave New York N Y.

Design for a Ring.—Patent 70982. R Rosenthal 609 Montgomery St, Brooklyn, N Y.

Design for a Doll.—Patent 71095. O B Winters c/o Butler Carteson Erwin Wasey & Co 250 Park Ave New York N Y.

Design for a Lamp Pedestal or Similar Article.—Patent 71107. L H Gorowitz 1305 Prospect Ave Bronx N Y.

Design for a Vanity Case.—Patent 71147. M Kline c/o Superior Products Corp 3 W 29th St New York N Y.

Design for a Shoe.—The inventor has been granted two patents 71137 and 71190. F Davis c/o Franklin Simon Co, 38th St. and 5th Ave, New York, N Y.

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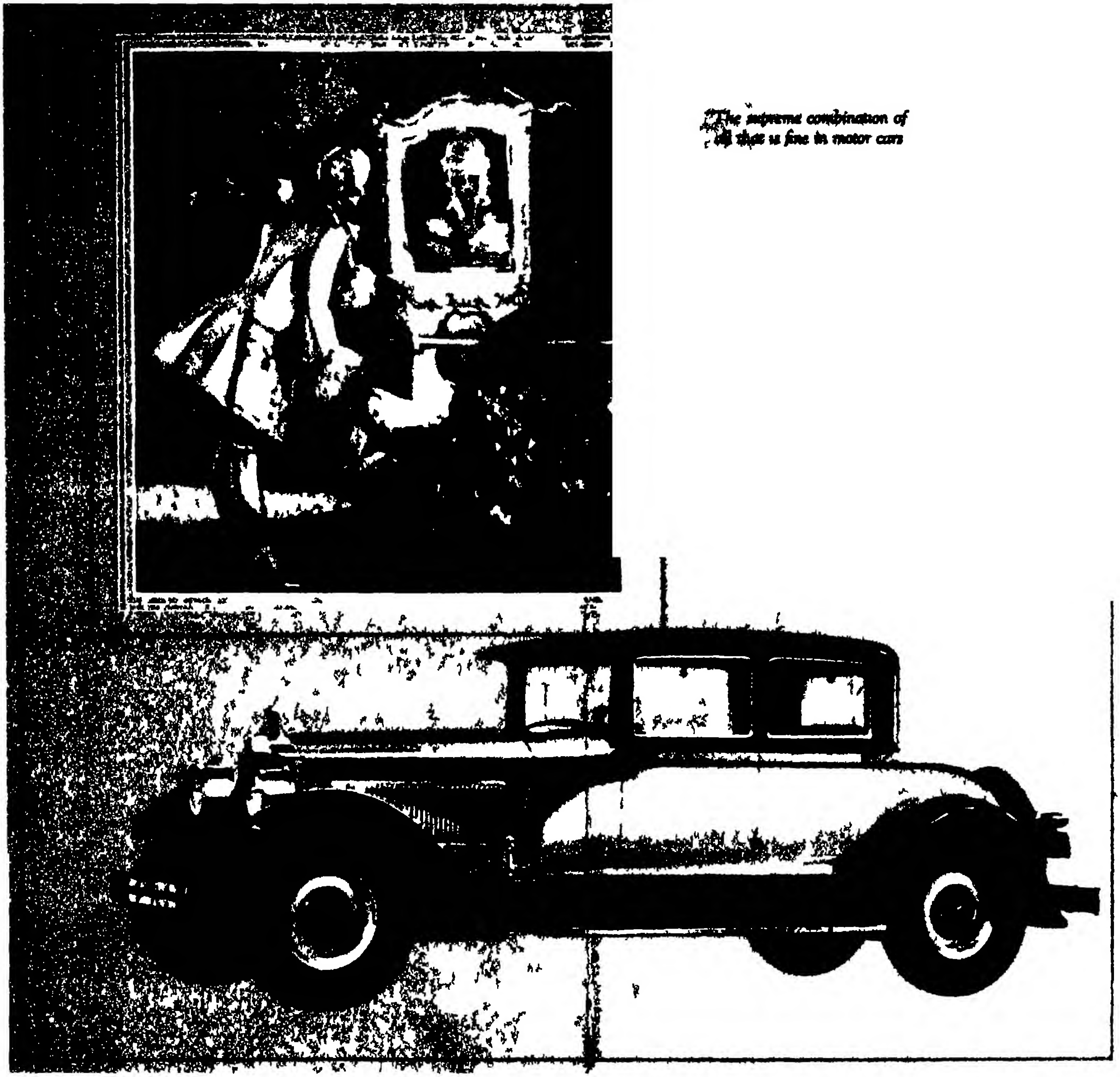
Lack of space makes it impossible to give many cross-references or to enter a given reference in more than one place Each article is therefore entered where it is believed it will be most easily found. In every case, the general subject should be sought rather than the supposed specific title of an article. We call special attention to the classifications Aviation, Radio," etc., under which many items will be found whose location otherwise would be very puzzling The asterisk (*) indicates that the article in question is illustrated


NEWS



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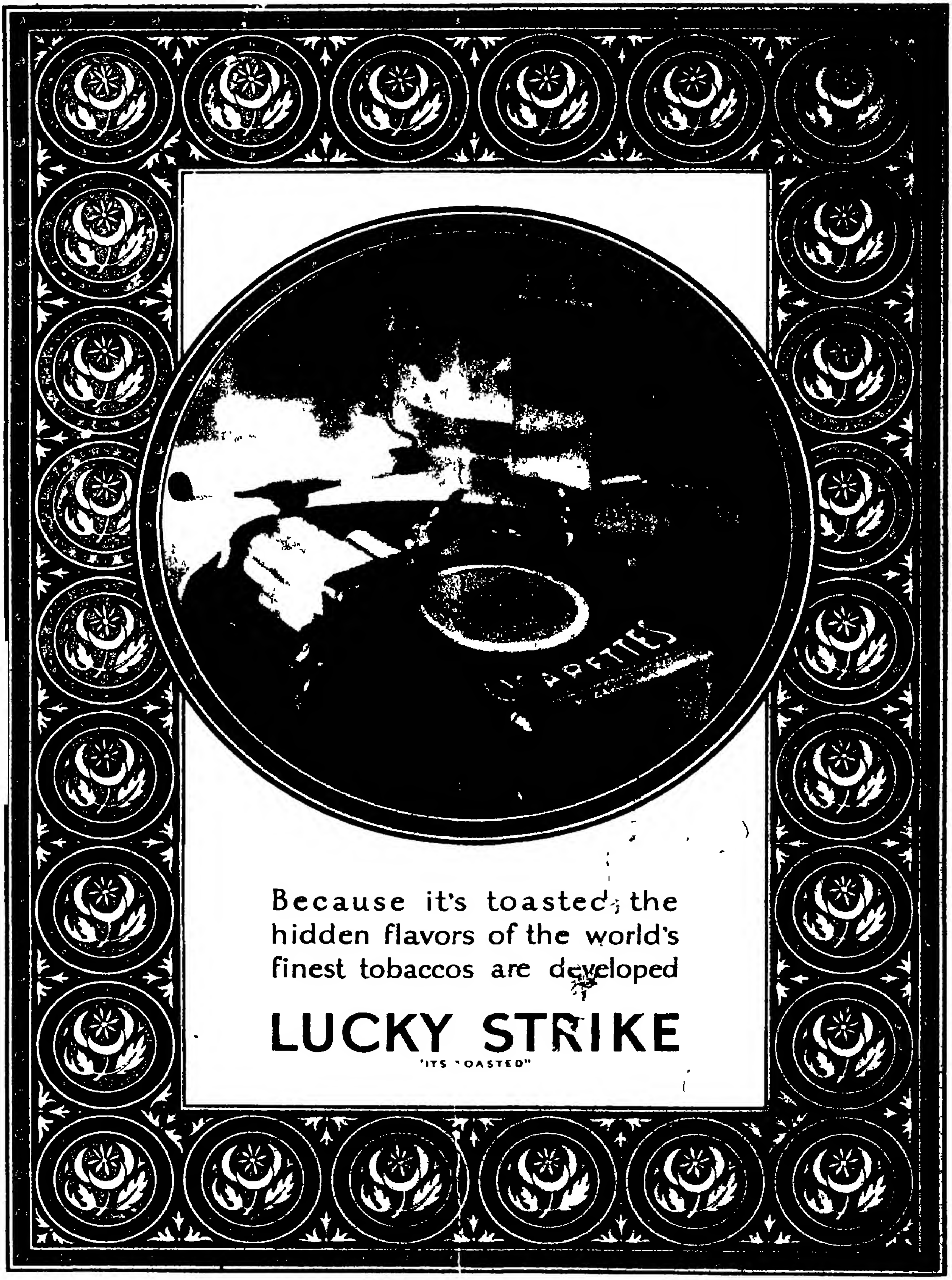
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